4. Mega-projects and their impact on the regional development in East Amazonia: The Grande Carajás programme (PGC)

4.1. Programme concept, implementation, and targets of the PGC in a transition period to the "New Republic"[84]

In October 1980, the Brazilian President General Figueiredo approved an extensive regional development programme called Programa Grande Carajás (PGC). A region with an area of around 900 000 km² was included as the programme area, located to the north of 8° S between the Amazon, Xingu, and Parnaiba rivers, and covering large parts of the states of Pará and Maranhão (96 % of the state area) and the northern part of Goiás (since 1988 state of Tocantins) (Fig. 11). In 1985, 68 % of the PGC region was covered by tropical rain forests.

The Interministerial Council of the PGC within the Secretariat for Planning (SEPLAN) of the Presidency of the Republic was created as the responsible organisational structure. The new institution had superior executive functions and was placed over the regional development agency for Amazonia (SUDAM), and the state governments. The PGC proudly was announced to be the world's major integrated development project. Investments of about US$ 62 billion and annual revenues of US$ 9–10 billion were scheduled by Minister Delfim Neto within the main sectors mine-metallurgy, agriculture, forestry, and infrastructure.

Priority targets of the PGC (CIPGC 1981) according to SEPLAN (1985):

1. Infrastructure:
   - the Serra dos Carajás - Ponta da Madeira railway,
   - the Ponta da Madeira seaport – system,
   - the Carajás export corridors,
   - facilities for the utilization of waterways for transportation of large masses,
   - transportation infrastructure and equipment,
   - the hydroelectric utilization of the hydrographic basins, especially the Tucuruí project on the Tocantins river.

84 This chapter is based on an evaluation of the Programa Grande Carajás for the German Agency of Technical Cooperation (GTZ) by the author (Kohlhepp *et al.* 1987); Kohlhepp (1985; 1987b).

2. Projects in the fields of:
   - prospecting, extraction, processing, and industrialization of minerals,
   - agriculture, cattle ranching, agroindustry, fishery,
   - forestation, reforestation, processing, and industrialization of wood,
   - utilization of energy resources.

In the start phase of PGC, besides the dominating Carajás iron ore project with its extensive infrastructure the aluminium industry, located at São Luís (Alumar) and at Barcarena near Belém (Albrás/Alunorte), the hydroelectric power station at Tucuruí on the Tocantins river and the large-scale agricultural and agro-industrial sectors gained priority.

Due to the export orientation of all PGC projects and the exceptional importance of the Japanese market during this period and previous contacts with Japanese institutions by order of the Brazilian Government, studies on regional economic development of the PGC region were elaborated by the National Development Centre of Japan (IDCJ) and the Japanese International Cooperation Agency (JICA) (IDCJ 1980; JICA/PGC 1985). In particular, the PGC's agricultural planning was initially strongly influenced by the IDCJ studies, but the proposals turned out to be unrealistic and not at all adapted to the ecological and social conditions of the programme region.[85]

A special and very extensive system of tax and financial incentives was granted to all projects approved. Exemptions from income tax for a period of ten years, exemptions of reductions of import duty and industrialised products tax, issue of licenses for import of machines and other equipment were granted. Furthermore, authorisation of foreign loans and guaranty of the National Treasury to these loans and reduced prices for energy were conceded to those undertakings, installing, expanding, or modernising projects in the PGC area.

In 1981, the Military Government stated that the private sector with small and medium enterprises should be supported, and foreign participation was welcomed in the implementation of PGC.

The delimitation of the programme area was based on three premises (see Fig. 11):

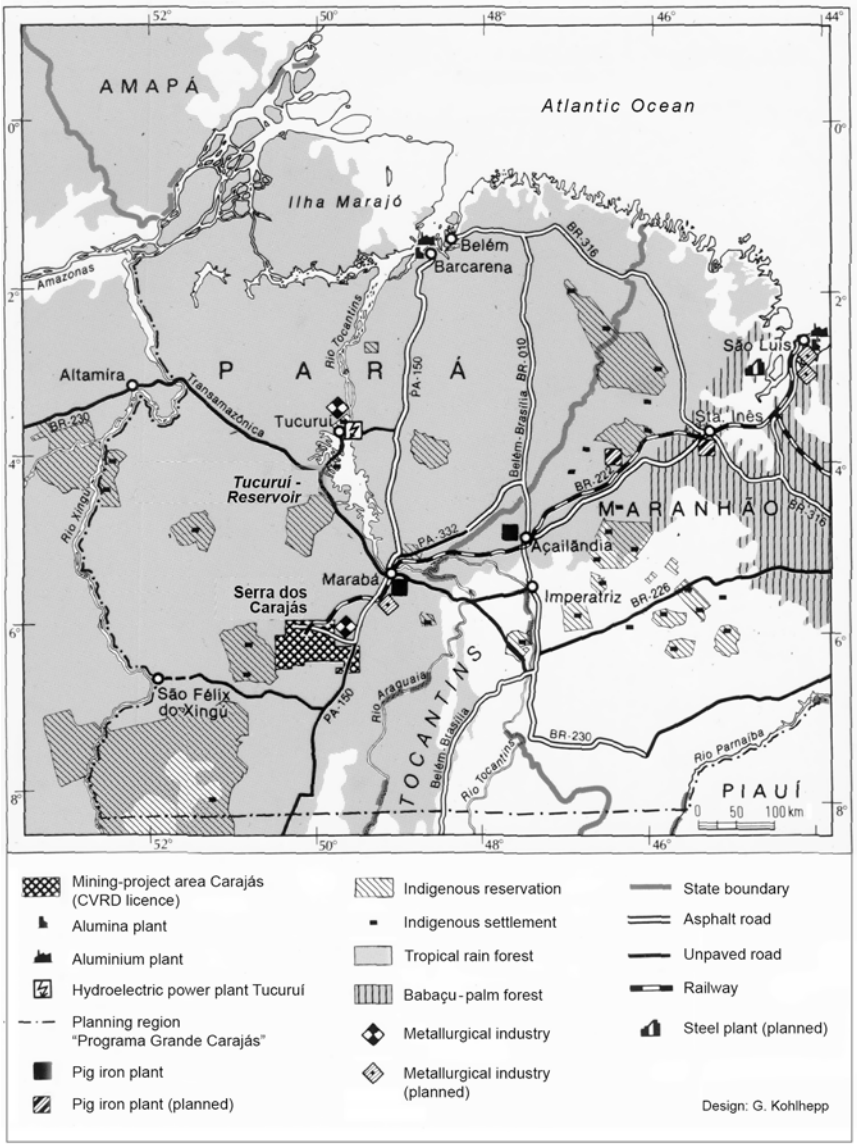
1. Including as central part the mineral province of the Serra dos Carajás, 550 km southwest of Belém, with its enormous iron-ore and other ore deposits,
2. including the future "export corridor" along the railway to the port near São Luís in Maranhão,
3. including the waterway Araguaia/Tocantins with its important hydroelectrical potential.

The Interministerial Council (IC) was authorised to give directions to all federal agencies. Regional planning concepts were elaborated by the Executive Secretariate of PGC and approved by the IC (CIPGC 1981)[86] and should be integrated into the development planning of the regional superintendencies SUDAM, SUDENE and SUDECO, which were responsible for the sub-regions concerned.

85 See chapter I.4.6.

86 PGC data in this chapter from CIPGC (1985; 1986).

Fig. 11: Mining and industrial sites in the planning region of the Programa Grande Carajás



Source: Based on documents of PGC and CVRD; Cf. Kohlhepp (1987b, 217).

Numerous problems of superposition of jurisdiction prevailed in the PGC region. SUDAM and SUDENE areas had an intersection of 246 000 km². Considering the different ecosystems and the difficult socio-economic conditions of the programme area involved, it remained undefined what strategy to be used exactly for the area of intersection. The PGC region was for the most part (92.5 %) in the area of the planning region Amazônia Legal, the sphere of influence and control of SUDAM in Eastern Amazonia. However, SUDAM officials did not participate in the conferences and decisions

of the PGC Interministerial Council. SUDAM was deprived of its previous importance but at least partially could be blamed for this situation, because it never developed a specific regional strategy. Most of the projects did not meet regional needs and had no social nor environmental consciousness.

The authoritarian military regime had installed a centralised administration structure subordinating the Amazonian periphery totally under the control of Brasília. The planning conception of PGC developed from the ideology of economic growth-oriented planning without taking into consideration socio-economic or ecological particularities, not to speak of reflections about basic needs of the rural poor population (Martins 1987). As a model of "development from above", PGC planning did not give emphasis to human resources development nor to integrated rural development. Nearly at the same time, the Polonoroeste programme had been announced. This programme of regional development in Rondônia and parts of northwest Mato Grosso based on a World Bank loan was at least planned with an integrated rural development approach.[87] Even if this programme failed on some points, the difference in planning ideology was more than obvious.

The situation was particularly complicated in the rural areas, where INCRA, GETAT, the state jurisdiction and the "special status" of some areas competed with each other. GETAT's executive units, which had been established in the Araguaia-Tocantins region in 1980, could not contribute to calming the land situation.[88] Unclear distribution of responsibilities in planning or even unrealistic solutions of project implementation could be observed in the PGC region. The social and ecological implications of large projects directly interfered with the municipal development of the affected areas. Decisions on the federal government's level regarding large projects were by no means coordinated with municipal problems and planning necessities. Even worse, the consequent costs of these projects remained with the state or municipal administration which were neither prepared nor financially in a position to solve the enormous problems. Marabá and São Luís are two very clear examples of a complete lack of coordination between the vertically different planning levels.[89]

With the end of the Military Government, since April 1985 the new democratic government of the *Nova República* in Brazil was confronted with a regional development programme, planned and executed by the authoritarian regime of its predecessors. There was a chaotic situation with the distribution of land titles, invasions and land conflicts of all kinds.

As for the new directions of PGC, a Consultative Commission of Science and Technology had been established to evaluate the environmental or socio-economic implications of large development projects. The scientific community in Brazil severely complained of lacking consultation, missing fundamental discussions and information regarding PGC sectoral and regional planning. Brazilian scientists deplored unchanged authoritarian structures in decision making in the PGC administration. In fact, there was no structural modification of PGC administration and planning strate-

87 Cf. chapter I.2.

88 GETAT (Grupo Executivo das Terras do Araguaia-Tocantins) was founded in 1980 as land regulation authority. In the mid-1980s, GETAT did land survey and land registration for about 50% of the PGC area. There was a strong connection with the SNI (National Intelligence Service).

89 Cf. Chapter I, 4.4.

gies. The mere participation of the governors of the affected states in the IC conferences of the PGC was the only signal of the new government of an "opening" of the basis of information. But it was an important step, because the regional reaction against the implementation of large-scale projects "from above" with far-reaching negative regional impacts proved to be a constant conflict between federal and state governments or agencies.

The formulation of general statements such as the reduction of regional disparities or socio-economic deficits was followed by the announcement of a necessary improvement of medium-sized structures in all economic sectors. In fact, large infrastructural and export-oriented projects of national interest still played the most important part in the reformulated PGC. However, an internalisation of large projects' benefits within the PGC region was considered to be important. Programmes of social development, democratisation of information, work, and production means and the organisation of communitarian participation were announced to be realised.

It became apparent that the effects of large-scale projects had already caused considerable damage and spatial disorganisation with absurd polarisation processes and intraregional instability since 1980. Most of the large-scale projects had been planned and implemented without detailed pre-studies of impacts on all levels, neither physically nor financially. This had only partially changed when particularly the World Bank and the European Economic Community had combined specific conditions with their loan commitments and therefore interfered indirectly into planning conceptions. At least some modifications and complementary actions could be realised. As these loans concentrated on the Carajas iron ore project, only this part of PGC had been substantially reoriented in close cooperation with the responsible project agency of Cia. Vale do Rio Doce (CVRD).

The PGC was approved at a time when the economic growth rate in Brazil under a high-growth and export-oriented strategy of the Military Government still exceeded 7 % per year (1973–1980), despite the oil price crisis which severely affected the country. External credit was widely available, causing Brazil's external debt to grow rapidly. In the late 1970s, the economic growth had been accompanied by accelerating inflation.

In 1981, the industrial recession had started and severely threatened the economic growth strategy. Thus, the government's goals of increasing export revenues through the valorisation of natural resources, especially in the Amazon region, have been reinforced. Even high investments were accepted in order to increase exports and reduce the burden of foreign debt. According to the government, the PGC seemed to be a way out of the crisis.

The PGC concept was highly risky, as the world market for iron ore in particular had been in overproduction since the decline in iron ore consumption in 1976 and even more so in the 1980s. In the beginning of the 1980s, world-wide iron ore output had been sharply reduced, just at the time when Brazil wanted to increase its production and exports. In 1980, Brazil had reached its maximum iron ore production to that time (95 mt). Between 1979 and 1982, world crude steel production dropped by more than 100 mt to 646 mt (-14 %)[90] due to production cutbacks in western industrialised countries, especially in the United States, but also in Japan.

90 Data: Cf. Kohlhepp (1987b, 221).

This must have been an alarming scenario for the start of a large iron ore mining project in Brazil, being the fundamental part of the PGC. The critical world market situation had a particularly negative impact on Brazil as the second iron ore producing country of the world and the most important exporter (25 % of world iron ore exports). Export prices had increased to a maximum in 1980 and had a sharp downturn thereafter (see Table 9). This was the case with other export-oriented ore and metal products which were of future importance within the PGC projects. Export prices of bauxite constantly decreased from 1980 to 1984, remaining stagnant since then. Aluminium prices had a collapse in 1981/82, continuing very unstable with marked ups (1984) and downs (1986), but remaining always far below the 1980 level.

Table 9: World market commodity prices of iron ore and non-ferrous base metals 1980–1987 (Index 1980 = 100)

Commodity	1982	1984	1986	May 1987
Iron ore	96.2	84.8	80.3	75.6
Manganese	105.7	92.2	90.7	88.6[1)]
Copper	67.8	63.0	62.7	69.5
Bauxite	98.1	77.6	77.3	77.6
Aluminium	55.9	70.5	64.8	79.5
1) March 1987				

Source: IMF (International Monetary Fund): International Financial Statistics, July 1987.

In the planning schedules of PGC and the Carajás iron ore project, increases in real prices had been projected for the second half of the 1980s. Unfortunately, these optimistic forecasts, even of international experts, failed. The decline in iron ore and non-ferrous metal prices on the world market was an extremely poor basis for the PGC, its implementation and its ultimate economic value. As revenues fell short of expectations, export earnings could not compensate for the overall investments and especially the constantly rising financing costs. Due to the prevailing uncertainty and high financial risks, some of the PGC projects, e. g., in the alumina and aluminium sectors, had to be postponed and the budget calculations and loan agreements of the projects had to be reformulated.

When the PGC concept was published, the Brazilian and the international public were at least surprised by the financial dimensions of projected investments. It was particularly emphasised that large-scale capital imports with high interest rates in credit contracts would further accelerate the rapidly rising external debt. Furthermore, critics were worried about optimistic calculations in all programme sectors, considering the extremely tough situation of raw materials on world market level, the decay of the US Dollar and the world-wide economic crisis. Finally, protest arose because the socio-economic and environmental impacts of these large-scale projects and the related social and ecological costs were not duly considered.

As programme planning was neither discussed in public or coordinated with regional entities, nor adapted to the basic needs of the affected regional population, PGC represented a typical example of a "development from above", planned and started by a

military government, and afterwards confronted with a strong opposition in the now democratic Brazil.

Table 10: Projects approved within the Programa Grande Carajás in 1986 (until May 31, 1986)

Projects	**Number of projects**	**Investments**		**Proposed number of jobs**		
		million CZ$***	%	direct	%	indirect
Mining*	2	59 714	30.0	7035	15.0	90
Electrical energy	1	68 669	34.6	**22 000	46.9	
Industry Total	35	65 493	33.0	16 562	35.3	32 941
Alumina	1	10 659	5.4	763	1.6	
Aluminium	2	44 585	22.5	5523	11.8	
Pig iron	8	1409	0.7	2099	4.5	15 465
Ferro-manganese alloys	2	626	0.3	754	1.6	3902
Electrolytical manganese	1	505	0.3	321	0.7	
Metallurgical silicium	1	1436	0.7	1251	2.7	
Metallurgical	2	10	0.0	89	0.2	62
Cement	2	1142	0.6	1472	3.1	2900
Timber	2	72	0.0	464	1.0	1132
Charcoal	3	313	0.2	1382	2.9	4700
Fertilizer	1	1838	0.9	404	0.9	2000
Agro-industry	10	2898	1.4	2,040	4.3	2780
Cattle ranching	5	112	0.0	342	0.7	
Agrarian colonization	1	637	0.3	1000	2.1	
Tertiary sector	1	4240	2.1	?	?	
Total	**45**	**198 865**	**100.0**	**46 939**	**100.0**	**33 031**

*) Incl. Transport and export of iron-ore

**) Incl. sub-contractors' companies (with temporary employment)

***) Cruzado (CZ) = From 1986 new Brazilian currency

Source: Kohlhepp (1987b, 244, Table 2). Own compilation by the author, based on individual project data of approved projects; received at CI-PGC in Brasília, September 1986.

Investments of US$ 62 billion were planned in a period of less than 10 years and considering the high interests this sum would amount to more than US$ 100 billion. But

that was only the PGC, not to mention other gigantic projects, the Itaipu hydroelectric power plant, the *pró-álcool* programme, the *polos petroquímicos*, the nuclear energy programme and several other mega-projects in other regions of Brazil.

Table 10 shows the situation of the 45 individual projects approved by the PGC by mid-1986. The dominating Carajás iron ore project (Ferro-Carajás), the aluminium industries and the hydroelectric power plant Tucuruí concentrated 92 % of the planned investments and 75 % of the number of direct jobs. The total number of direct jobs given by PGC was 47 000, but since subcontracted construction workers in Tucuruí were included, this number must be reduced by 20 000. Tucuruí had less than 2000 permanent jobs and some other projects had about 4000 jobs less than previously announced The PGC projects approved until May 1986 had only about 23 000 permanent jobs. In view of the number of investments of about US$ 12 billion and high financing costs this was an extremely low number of new jobs. The indirect jobs mentioned in Table 10 refer to contractors and services, e. g., for charcoal supply – nearly half of the total of 33 000 jobs with no official employment contract.

The total investment for the approved projects amounted to US$ 14.2 billion, 35 % for Tucuruí, 33 % for all the industrial projects (28 % aluminium and alumina production) and 30 % for the Carajás iron ore project. 62 % of the investments were internal cash generation by the investors, 51.1 % of the total investments were national capital, 48.9 % foreign capital.[91] Some of the smaller and medium-sized projects were based on tax incentives rather than on long term solid economic planning. Even five cattle ranching projects had been approved, an absurd situation considering the intense discussion in Brazil and internationally on the negative ecological and socio-economic impacts of pasture expansion in tropical forests of East Amazonia.

The Programa Grande Carajás turned out to be *the* extreme mega-project in the Amazon region, established without ecological and social commitment. It was a regional planning strategy to integrate Amazonia into the world market without considering the fragile world market situation of ore and metallurgical commodities. The PGC has been a megalomaniac attempt of the military regime, continued by the democratic governments to demonstrate the potential of Brazil as leading power in the southern hemisphere. Amazonia and its population had no chance to intervene in the government actions.

4.2. The Carajás iron ore project of the Cia. Vale do Rio Doce

4.2.1. CVRD's "northern system" and its importance for the Grande Carajás Region

The Cia. Vale do Rio Doce (CVRD) iron ore project was not only the core project of the PGC, but also the reason for a regional development programme organised as part of the PGC planning.

Founded in 1942, CVRD was a majority state-owned company until its privatisation in 1997. It was traditionally active in iron ore mining but has diversified its activities. CVRD was a very efficient state company, acting with modern management

91 PGC information to the author in September 1986.

characteristics, a holding controlling 86 subsidiary companies and participating in 66 others. Already in 1986, CVRD had been a vast mining and industrial complex producing and selling iron ore, pellets, manganese ore, bauxite, aluminium, gold, titanium ore and wood pulp, and also running railways, ports and ocean transportation (CVRD 1985; 1986). 22 500 people were directly employed, a total of 60 000, counting all the subsidiary companies. CVRD and its activities had been of highest importance to the Brazilian economy and remained at this level (CVRD was renamed in Vale S.A. in 2007). As a carrier of state economic strategies, CVRD implemented and organised an extensive infrastructure network and played an important role not only for economic development but also for regional development.

The traditional centre of mining operations has been the state of Minas Gerais, linked by a highly efficient railway transportation system (Vitória-Minas-railway) with the state of Espírito Santo, where industrial beneficiation plants and large port installations (Tubarão) are located. This "southern system" of CVRD activities, diversified by wood pulp and the reforestation sector, pig iron and ferroalloy industries and a strong cooperation with Japan in the *cerrado* programme[92] was completed by the "northern system" in the Carajás area in East Amazonia.

In 1966, geological survey rights in the Serra dos Carajás region had been granted to CVRD and the Cia. Meridional de Mineração, the Brazilian subsidiary of US Steel. Enormous iron ore and manganese ore deposits were discovered in 1967. In April 1970, a joint venture (AMZA) had been founded between CVRD and US Steel to undertake feasibility studies of the exploration of the iron ore reserves and the implementation of an iron ore project. From the Brazilian point of view this was an excellent possibility to expand the access to the US market, to receive international credits and transfer of know how. In May 1974,[93] a first Carajás project had been conceived and iron ore export planned to start in 1979. The possibility of iron ore transportation by river barges on the Tocantins river was rejected because of missing facilities for a deep-water port at Belém/Pará. Due to the necessary tonnage of large iron ore carriers used in international trade, the port location of Ponta da Madeira near São Luís in the state of Maranhão proved to be the most favourable location. In 1976, AMZA was granted the concession of railway construction between Serra dos Carajás and the port of Ponta da Madeira.

In June 1977, US Steel withdrew from the joint venture in view of project costs, the necessary increase in investments and the difficult situation of the international iron ore market as well as the world crisis in steel production and consumption. Furthermore, the target markets had shifted from the United States to Japan and Western Europe. CVRD acquired the Meridional/US Steel shares in AMZA, US Steel remaining with an option to buy up to 50 % of the iron ore production of Carajás.[94] CVRD's tenta-

92 In the Regional Development Programme in the *cerrado* area of Central Brazil (*Polocentro*), a bilateral agreement with Japan established a development programme for the *cerrado* in Minas Gerais and Goiás. Studies were undertaken by the Japan International Cooperation Agency (JICA). The intense relations with Japan originated from iron ore exports to Japan, and the Japanese demand for grains.

93 During the first visit of the author in July 1974, aircraft landing at Serra dos Carajás occurred on top of the Serra on a roughly graded *cerrado* surface as landing strip. Geological field work, preparation of the mining site and road access for transport of heavy machinery were still in full action. Geologists had to be transported by helicopter to the different locations in the rain forest.

94 Cf. CVRD documents and articles in *Jornal da Vale* (CVRD 1986).

tive to find an adequate counterpart for a new joint venture failed, when Nippon Steel, British Steel and a Spanish Steel Co. desisted from participation due to the high infrastructural investments necessary, particularly for the railway construction.

New studies on optimal production in the Carajás region were completed in 1980. The project scope was substantially reduced in transport capacity from 50 to 35 million t per year and electrification of the railway to the port was no longer included in the project implementation. In October 1980, the Carajás iron ore project was formally approved by the Brazilian President, CVRD being authorised to arrange domestic and international loans. Civil works of railway and port construction already had started. Operations of the beneficiation plant started in 1981 and contracts with 19 clients from Europe and the Far East were signed. Finally, the rights to use the 429 000 ha concession area at Serra dos Carajás were granted to CVRD by the Interministerial Council of PGC. Due to the world economic situation, implementation schedules of the project had to be revised several times, but in 1986 all project parts were in full action according to the revised schedule.

CVRD's "northern system" gained a superior importance within the PGC and the related regional development plans. Diversification was realised by investing in the bauxite and aluminium sectors. The concept of the Rio Doce export corridor of the Vitória-Minas-railway was transferred to the Carajás railway corridor in combination with a regional development programme such as that of the Southeast. But due to financial restrictions, political changes and PGC revisions, particularly in the agricultural sector, the conceptions of JICA could not be realised.

With the Carajás iron ore project, CVRD had strengthened its position as one of the largest mining enterprises worldwide and certainly world's largest iron ore producer and exporter in the second half of the 1980s, combining the two regional systems (1987: 75 mt). The Carajás iron ore project absorbed the bulk of CVRD's investments. Until the end of 1986 direct investments amounted to US$ 2.7 billion. According to the provisional financing plan (1978–1987)[95] for the iron ore project, 38.1 % (US$ 1.79 billion) of the capital investments planned (US$ 4.7 billion) were from CVRD internal cash generation and new capital subscription: 33.5 % (US$ 1.58 billion) from foreign loans (World Bank: US$ 350 million; European Economic Community EEC: 450 million, Japan: 530 million, German KfW: 150 million and US financial institutions: 95 million) and 28.4 % (US$ 1.34 billion) from national sources (BNDES: US$ 700 million, FINAME: 402 million, among others). Nearly half of the direct investments (49.4 %) were absorbed by the railway construction, 13.7 % by the mine, 6.8 % by the port, 4.2 % by townsites and 25.9 % were necessary for administrative and engineering purposes (CVRD 1986).

Environmental and human rights concern rendered the EEC involvement in 1982 more difficult. A World Bank loan was granted with special conditions on Indigenous and environmental protection. Additionally, the effectiveness of the Japanese, the EEC and the German KfW loans were a condition of the proposed World Bank loan. Within foreign loans, the Japanese part was the most important.

Although overproduction, the global economic recession, lower iron ore prices and the specific crisis in the pig iron and crude steel industry made the situation even more

95 Source: Coffey (1985, appendix No. 1); data: Lloyds Bank international; Cf. Kohlhepp *et al.* (1987, Table 10).

difficult, high-grade Carajás iron ore obtained considerable advance contract commitments from steel producers in Western Europe and Japan. As high-grade hematites became depleted in Minas Gerais, CVRD's "northern system" gained high reputation on the iron ore market and extensive contracts were signed.

The installation of the Carajás iron ore project had a considerable influence on the regional employment. During the construction period in the first years of the 1980s, a maximum of over 27 000 workers was employed, in April 1986 still 15 200 employees were engaged in the Carajás iron ore project in construction (43 % employed by contractors), operation, administrative support and maintenance. Finally, there were about 6000 permanent jobs, 60 % for higher, intermediate, and qualified staff. In the end of the 1980s, the annual iron ore production at Carajás was up to 35 million t.[96]

4.2.2. Carajás iron ore reserves and mining

The Serra dos Carajás region is covered by dense tropical rain forests, except for the iron ore bearing *mesa* type *cerrado* clearings above 700 to 900 m above sea level. The *mesas* are of special importance to infrastructural installations like the airport, the townsite and roads. The Serra dos Carajás comprises roughly east-west stretching ranges: Serra Norte, Serra Sul, Serra Leste and Serra de São Félix between 5°50'S and 6°35'S, 49°30'W and 50°45'W. Rock formations exposed in Carajás are of precambrian age. From base to top they include a granite-gneiss basement, a suite of meta-sedimentary and volcanic rocks and sequence of sedimentary clastic rocks. Intrusions are represented by granite plutons. Tectonically, the structure of the Carajás district is a faulted synclinal ridge (Santos 1986, among others). Serra Norte and Serra Sul being respectively the north and south limbs in a distance of about 40 km from one another. There are several large high-grade hematite deposits.

The main iron ore deposits are located in the Serra Norte and Serra Sul. From the five orebodies existing at the end of the 1980s, four were in the Serra Norte with a maximum deposit in the Serra Sul (Table 11 and Fig. 12).[97]

Table 11: Serra dos Carajás: Iron ore reserves (million t = mt)

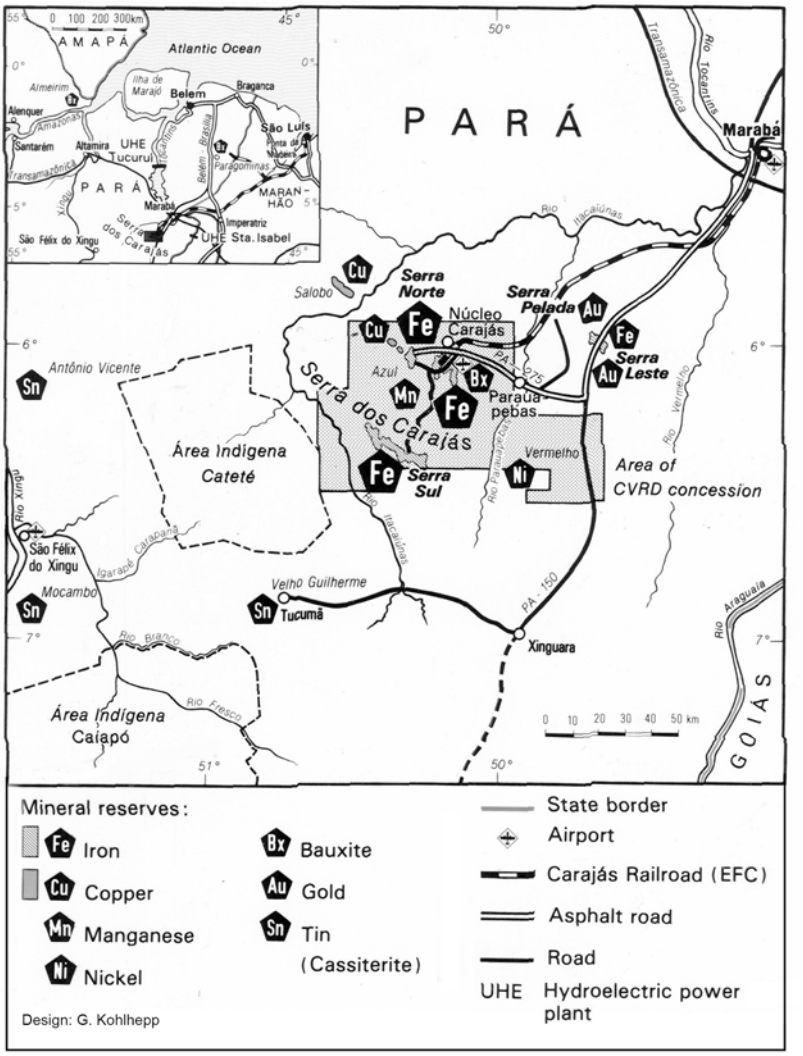
Sector	Deposit	High-grade		Medium-grade		Total	
		mt	% Fe	mt	in %	mt	% Fe
Serra Norte	N1 - N8	5257	66.7	915	60.8	6172	65.8
Serra Sul	S11	9475	66.8	860	61.1	10 335	66.3
smaller deposits		1019	66.7	359	60.8	1378	65.9
Grand Total		**15 751**	**66.7**	**2134**	**60.9**	**17 885**	**66.0**
High-grade: >64.0 % Fe; Medium-grade: 55.0–63.9 % Fe.							

Source: Research Report AMZA; Santos (1986).

96 In 2021, the Carajás iron ore production at Serra Norte amounted to 110 million t, at the new Serra Sul mining complex (S11D) 73 million t. See details in chapter II.6.3.1.

97 On the development of iron ore mining at Serra Sul, see chapter II.6.3.1.

Fig. 12: Serra dos Carajás. Mineral reserves



Source: Kohlhepp (1987b, 223); based on documents of CVRD and Ministério das Minas e Energia (1981).

Total high-grade reserves, including smaller deposits, were estimated to 88 % of the reserves, i. e., 15.8 billion t (bt), the grand total of the iron ore reserves being 17.9 bt. In the 1980s, this was the largest iron ore deposit worldwide. It exceeded by far the CVRD iron ore reserves of high-grade hematite in Minas Gerais (2.0 bt), the traditional mining centre of Brazil. The average grade of high-grade ores in Carajás was more than 66 % Fe, even the medium grade ores contain 61 %. Particular attention was paid to the N4-deposit in the central part of the Serra Norte. According to the ore quality and reserve size, but especially because of easier railway accessibility in this part of Serra Norte, N4 was selected as the site for mining start-up in Carajás. Iron ore reserves of 1.28 bt were measured, which corresponds to two-thirds of the total measured reserves. Three basic ore types, classified according to grain-size distribution of "in situ"

ore, build up N4 orebody: Friable hematite (84 %), hard hematite (9 %) and soft hematite (7 %). Friable hematite represented the main ore type but did not outcrop. It was covered by *canga*, a crust of ferrous material. Between 1982 and 1986, 12 mt of *canga* had been removed so that open pit mining was possible.[98]

The friable hematite is a natural sinter-feed of excellent quality. A pilot plant at N4 produced one million t of sinter-feed in 1984 and 1985. It was used for quality tests at steel plants in Brazil, Japan, the Federal Republic of Germany and in the US with good results. While sinter-feed nearly exclusively was exported, the natural coarse products were used in the pig iron plants along the railway.

Open pit mining was organised in 15 m high benches. Huge excavators and trucks with a loading capacity of up to 170 t were operating at the mining site, transporting the ore to the near primary crusher. Crushing and screening was organised by computerised techniques at 8000 t/hr. The ore beneficiation area was implanted on the east flank of the N4 reserve with a difference in altitude of about 350 m in an exemplary lay-out with a hydroseeded vegetation cover, contour and draining works as an effective prevention of erosion. The stockpile area had a capacity of 1.6 mt at the beginning. In September 1986, the carloading terminal at the railway loop was working with 8000 t/hr. In between two or three hours an ore train could be loaded.

The implementation schedule for iron ore transport and export had been revised several times from 15 million t per year (mtpy) in the beginning of 1986 to the 35 mtpy-phase at the end of 1987.[99] Mining operations at N4 were scheduled for 303 days per year using three 8 hrs shifts/day. Considering the heavy financial restrictions in Brazil and the extremely difficult infrastructural situation with the railway construction, this was a very good result. Furthermore, the rainy season from November to April with 85 % of the average annual precipitation of 2040 mm (1980–1986) with heavy rainstorms and frequent fog at the altitude of mining caused considerable problems in the beginning of air transport, mining, and export activities.

Besides the huge iron ore reserves, the mineral potential of the Serra dos Carajás mining province is of outstanding diversification (Fig. 11). Large manganese ore deposits (65 mt) were discovered already in 1971. In 1985, a manganese ore beneficiation plant was producing manganese ore (1 mtpy) utilised in ferroalloy plants and battery-grade natural manganese dioxide for the manufacture of electrolytic batteries. The Azul manganese ore mine was used to primarily supply the domestic market. Only about 50 km northwest of the Carajás N4 iron ore mine there exist large copper reserves of about 1.2 bt at Salobo. Brazil urgently needed an increase in copper production, as copper imports in 1986 came up to about US$ 300 million. Although CVRD had planned a master plan for the copper project, including environmental studies, this project was not started until 2004, which led to severe conflicts in the region.

There are also considerable nickel, tin, bauxite, and tungsten deposits in the Serra dos Carajás mining province, prospecting activities were still continuing in the 1980s.

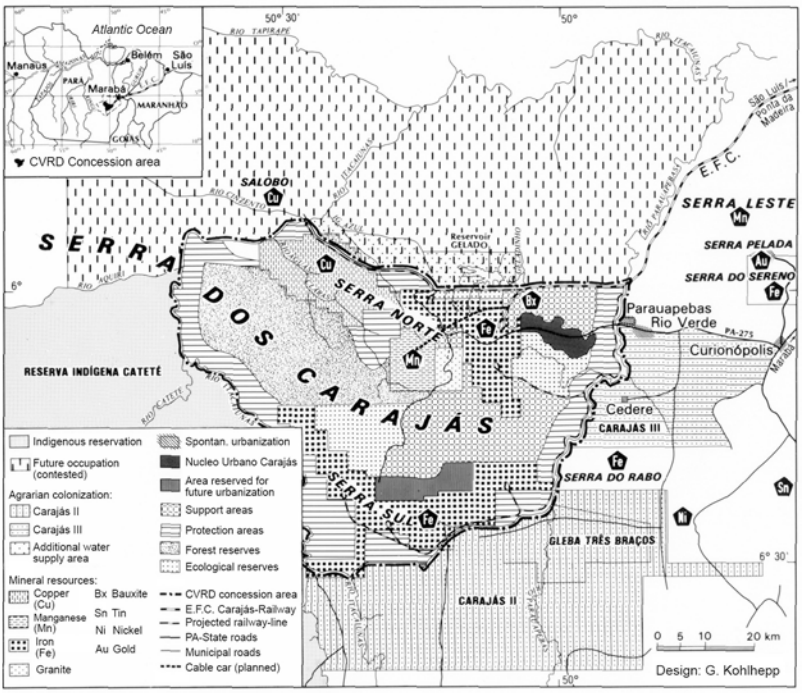
98 Vaz de Melo (1985); Santos (1986); Garrido Filha *et al.* (1988); Ab'Sáber (1996a, b, c); all details according to CVRD information and the Status Reports of CVRD.

99 During the first decade of mining from 1985 to 1996 more than 340 million t of iron ore were transported via the Carajás–Ponta da Madeira railway.

4.2.3. The CVRD concession area in Serra dos Carajás: An "enclave" of well-organised micro-regional planning and development versus a chaotic rural and urban situation "outside"[100]

The CVRD had a very distinct concept of spatial organisation within the 4290 km² concession area in Serra dos Carajás. According to the occurrence of mineral deposits, the geomorphological situation, the ecological conditions and the regional development goals, spatial planning was organised with a focus on the Serra Norte, which initially had the greatest importance. Buffer zones against threatening invasions are clearly documented in Fig. 13. Protection areas were planned along the east border with the colonisation projects (Carajás II and III) outside the concession area and along the Itacaiunas river, the western border in protection of the neighbouring Indigenous reservation Cateté. Between Serra Norte and Serra Sul large areas, which were not in use for mining activities, were marked out for natural rain forest and ecological reserves. A future extension of the CVRD concession area to the north was described as fundamentally necessary in view of future mining projects, especially the Salobo copper project, but was denied and only partially used for this project more than two decades later. Huge iron ore mining operations at Serra Sul (S11) started only in the 2010s.[101]

Fig. 13: Spatial organisation in the CVRD concession area in Serra dos Carajás



Source: Cf. Kohlhepp (1987b, 228); based on planning documents of the CVRD and additions by the author in Serra dos Carajás in September 1986.

100 This chapter is based on Kohlhepp (1987b; 1987c); Kohlhepp *et al.* (1987).

101 Cf. chapter II.6.3.1.

The main urban nucleus at Serra dos Carajás is located at an altitude of 640 m above sea level on one of the plateaus near the iron-ore mine on the paved PA-275 state highway inside the concession area. The location of the townsite is excellent for climatic reasons, although during the rainy period sometimes there is a problem of fog. The site was located on the prevailing wind side, away from the mining operations and so it is free of dust. The townsite primarily was planned by CVRD for the operational and maintenance staff of the mine and of the railway terminal at Carajás. Non-CVRD people involved in commercial, service, or small industrial activities in the townsite were housed – under protests – outside the concession area at the town of Parauapebas, an originally planned town under severe migration pressure and in 1986 with still chaotic urban characteristics. CVRD had bought the property of a cattle farmer from São Paulo who had ordered the first clearings at the site of today's Parauapebas.

In September 1986,[102] access to Serra dos Carajás was still strictly controlled at the entrance of the CVRD concession area to prevent problems of spontaneous migration invading the area. Only people with a specific charge within CVRD or contractors' operations were allowed to enter this area. The ground-plan of the townsite was a square with a rectangular quadra-pattern. Deforestation for the urban construction and for the airport (opened 1982, a 2 km runway; regular jet air traffic since 1985) was minimized. The functional equipment was exemplary: kindergarten, primary school, secondary school in planning, a large hospital, supermarket, shopping centre, social and sports clubs, cinema, guesthouse, and a hotel were existing, water and electricity supplied from Tucuruí, sewage, garbage collection, and telecommunication working. As there was no reliable regional food supply at the beginning, food for supermarkets and for the workers' restaurants was organised by a contractor with four trucks arriving daily from São Paulo.

The houses in the town belonged to the CVRD and the residents paid only a token amount per month. There were four types of houses according to professional qualification of residents. Urban landscaping, green belts along the peripheral main road and the state highway by-passing outside the townsite made this well-organised urban settlement a model of a typical company town, well known in Brazil.

There was a sharp social segregation between the privileged urban development of the CVRD "enclave" up in the mountains and the tense situation at the foot of the Serra dos Carajás outside the concession area, a conflicted situation severely criticised by the non-CVRD population. Mass migration triggered by large-scale projects, widespread activities of *garimpeiros* and their violent rebellion[103] against CVRD's planned mechanisation of gold mining, as well as spontaneous land occupation in the region made organisational control of access to CVRD's concession area inevitable due to the weakness or absence of state authorities.

Given the extreme isolation of Serra dos Carajás, the townsite was planned to be highly attractive to the new residents. 40 % of the staff came from the Southeast, had experience with CVRD mining in Minas Gerais or iron ore export in Espírito Santo, but were not familiar with the Amazonian reality. The specific age structure of a company town was present in Carajás: 40 % of the urban population were between 26 and

102 Situation during field work of the author in September 1986 in Serra dos Carajás and surroundings.

103 Cf. Serra Pelada, chapter I.1.2.3; Guerreiro (1984); Ab'Sáber (1996c); Becker (1988; 1994).

40 years, 32 % from 18 to 25, only 19 % less than 18 years and 9 % older than 40 years.[104] This indicated a high amount of single young workers or employees and young families.

The CVRD stressed that organisationally it was only responsible for the concession area and a narrow strip along the railway line to the port of Ponta da Madeira. However, in the regional, national, and international discussions about the Grande Carajás programme (PGC), the responsibility for the development problems and failures was given to the CVRD as the main actor.

Outside the CVRD concession area, spontaneously new settlements developed even before the gold rush at Serra Pelada started. This occurred especially along the connection road (PA-275) from the PA-150 to Serra dos Carajás (see Fig. 13). In 1980, Curionópolis emerged from a service centre for various *garimpos* in the vicinity. When Serra Pelada was still a restricted area, the supply of food, building materials and *garimpo* instruments was organised in this new agglomeration where alcohol consumption was abundant and prostitution was economically very important. Later, petrol stations, repair workshops, shops, cheap hotels, etc. were built.

In 1986, 25 000 people lived in Curionópolis, where urban infrastructure remained precarious. No paved roads, no conservation, no water pipes or sewage. Electricity was only supplied by private generators. Removal of garbage was inexistent. Most of the houses were simple wooden constructions, huts were covered with leaves or plastic material. At that time, Curionópolis was a typical pioneer settlement that lost some functions to Serra Pelada. In the beginning of the 1980s, Eldorado (1986: 8000 people) began to develop near the junction of the main roads mentioned. *Garimpeiros* with their families lived there. Commerce increased quickly and work contractors took hands from Eldorado. The admission of women in Serra Pelada relieved Curionópolis and Eldorado of their function as large brothels for the *garimpo* region.

The situation of the extremely bad state of the "asphalt" road from Marabá to Serra dos Carajás proved to be typical for the political conflict between federal, state government and private levels. The Pará state road department was responsible, but because of lacking financial means it wanted PGC or even CVRD taking over the conservation of this road. This made sense because the intensive truck traffic served to supply the CVRD in Serra dos Carajás. At the end of this road, immediately before the gate to Serra dos Carajás, two new settlements emerged: Parauapebas and Rio Verde (cf. Fig. 13).

The appointment of an advisory group (GEAMAM) by CVRD was, on the one hand, due to the conditions imposed by the World Bank, and on the other hand, CVRD's managers in Rio de Janeiro saw that the mining company was unable to solve the regional development tasks it faced in the Carajás region, with all their ecological, social and regional development problems. Especially because the administration of the Programa Grande Carajás (PGC) had not prepared the planning accordingly, this now became a task of CVRD (Ab'Sáber 1996c, 257 f.).[105]

104 According to CVRD statistics, evaluated in Serra dos Carajás in September 1986.

105 GEAMAM was an advisory group of outstanding Brazilian scientists who had been invited by the president of the CVRD, Eliezer Batista da Silva, following a new requirement of the World Bank for the granting of loans. GEAMAM played an important role in ordering the environmental and conflictual social situation in regional development and the urban settlements outside the CVRD concession area. GEAMAM, whose members included Warwick Kerr, Aziz N. Ab'Sáber and Herbert O.R. Schubart, made particular efforts to address the situation in the fast-growing, socially conflicted

The basic concept for the origin of Parauapebas was the strategy of CVRD to avoid large *favelas* in the surroundings of the townsite of Serra dos Carajás. However, large projects attracted a mass of construction workers, the majority employed by contracting companies. After termination of construction activities, unskilled workers were dismissed but remained living near the project. This caused considerable problems because they no longer had lodging facilities or a job. *Favelas* normally are the result of this situation. The idea was to instal a planned town – outside the company's borders – with a basic infrastructure in order to settle small industries and craftsmen, providing services to CVRD and the Serra dos Carajás area, offering jobs for the increasing young population.

The foundation of Parauapebas in 1982 was part of the CVRD spatial strategy to implant a belt-like buffer zone east of Serra dos Carajás to protect the concession area against invasions. The other part of this spatial organisation was the installation of the agrarian colonisation projects Carajás II and III south of Parauapebas (cf. Fig. 13). In Parauapebas a large hospital, a primary school, a police station, and a building for the *prefeitura* were constructed by CVRD. As already mentioned, in 1983 some public buildings were burnt during the Serra Pelada *garimpeiro* revolt.

While in Parauapebas official concessions were given to build houses and to instal shops according to the town planning draft, in Rio Verde nothing was planned, but services developed automatically. Numerous brothels opened. A major part of the population were migrants from Maranhão, people escaping from the 1985 flood in the Northeast and dismissed workers from Tucuruí. Many were recruited by subcontractors for jobs in Carajás. Later, peasants from the nearby colonisation projects and *garimpeiros* moved to Rio Verde.

Since 1984, the situation changed distinctly, especially in Parauapebas, where the standards fixed did not meet the basic needs and the previous "image" of a living area for migrants. Population pressure increased and the announcement of the new industrial district attracted even more people. Parauapebas turned from a planned to a spontaneously developing town. As politics changed, CVRD had to transfer the administration of the town to the municipality of Marabá. Immediately, Parauapebas was flooded by invasions. Within two years, the population increased from 2300 (1985) to approximately 25 000 in 1987. A commercial centre developed, and a sharp social segregation could be observed. The administrative change caused another conflict: The state of Pará health service could not finance the hospital. CVRD was urged by the population to maintain the installations but was no longer willing to keep the whole infrastructure of Parauapebas and surroundings going, as this was in state competence. The hospital remained in a desperate state.

In Rio Verde (1985: 9400; 1987: > 20 000 inhabitants), a basic spatial reorganisation was realised by GETAT. Despite its character of a pioneer town, a certain consolidation could be observed. The large prostitution area in the centre was transferred to another quarter. The efforts of GEAMAM members have made a significant contribution to the fact that the existing social tensions did not lead to further violent actions, even if not all the sensible suggestions of this group were implemented by CVRD.

settlement of Rio Verde, whose integration into the surrounding area was intended to help pacify a tense situation.

It became clear that the CVRD strategies did not address the scale of immigration to this region and that the PGC did not have a sound plan for orderly regional development outside the CVRD concession area. Migration was still increasing in the second half of the 1980s. Most of the migrants came from Maranhão (34 %) and other states of the Northeast (35 %), 11 % from Goiás and only 7 % were people from Pará. Nearly 50 % of the population of Parauapebas and Rio Verde were younger than 18 years, 39 % between 18 and 40 years.[106]

The closure of the outrunning activities in Serra Pelada at the end of the 1980s had a disastrous effect on the increasing social tensions. The state of Pará was not able nor willing to manage the existing and forthcoming problems. One of the fundamental problems was that the PGC did not implement a specific urban development programme in the mass migration regions that were directly affected by the socio-economic impact of the large-scale projects.

CVRD measures to protect the environment and the local population

Unfortunately, the regional development programme for Eastern Amazonia, the PGC, which started in 1980, did not include a specific environmental programme section. This was surprising, considering that the example of the environmentally conscious Polonoroeste programme was prepared by government agencies at almost the same time.

From the four large programme parts of PGC, the Carajás iron ore project was the only one caring of environmental protection. Due to the requirements of the World Bank and – given the size of the projects – the inevitably extensive interventions in the natural and socio-economic conditions, the CVRD assigned responsibility for environmental measures. This was based on the former Minas Gerais experience in 1973 and a research programme was initiated to analyse the environmental impact of the Carajás iron ore project. In 1980, CVRD expanded its activities in environmental research by creating an independent advisory group of outstanding Brazilian scientists and Amazon experts of different disciplines. In 1981/82, this group organised two permanent on-site internal environmental commissions for the mine site and the railway and port areas. They had to identify critical points regarding environment. Ecologists were responsible for monitoring and controlling the environmental aspects of the project (Goodland 1985; Freitas and Shluger 1983; Freitas 1986).

Research projects, symposia, seminars, and discussions were organised in close cooperation with Brazilian and foreign universities, scientific organisations, governmental agencies and international entities like the United Nations Environmental Programme (UNEP), Worldwide Fund for Nature (WWF), among others. Inventories of the regional flora, avifauna, vertebrates, ichthyology and on archaeological sites were carried out in an extensive programme with the renowned Museu Goeldi in Belém. Highest priority was given to projects on socio-economic impacts along the railway line and on water resources in the CVRD's area of influence. Special precautions were taken on the mine site for mine water. Two permanent dams were constructed, one for

106 Data from CVRD statistics and estimates in September 1986. In 2022, the municipality of Parauapebas had a population of 266 400 and a population increase from 2010 to 2022 of 73 %, one of the highest in Brazil (IBGE 2023). Parauapebas and Rio Verde have now grown together and form a conurbation of more than 200 000 inhabitants.

retention of the tailings from the industrial plant and impoundment of water for the industrial process, the other for retention of the fines from the northern dump site at the mine. In the port area of Ponta da Madeira, a pollution control project was carried out.

CVRD installed two large tree nurseries (Serra dos Carajás and São Luís) producing more than 600 000 seeds and sprouts of regional species for reforestation and re-landscaping measures. A botanical and zoological park (for regional species) at Serra dos Carajás supported the environmental education activities for schools and technical personnel.

CVRD mentioned costs of US$ 53.8 million for environmental activities related with the Carajás iron ore project in the period 1981–1985.[107]

The beginning of a new political period was confirmed by a seminar in Belém at the end of September 1986 on "The economic development and environmental impact in areas of the Brazilian humid tropics. The experience of CVRD" with national top-level officials of CVRD and PGC-SEPLAN, other national and international agencies, but especially Brazilian (GEAMAM group) and foreign scientists. This seminar was the first high-ranking event in Amazon affairs in Brazil with open public discussions in impressive frankness. However, this did not eliminate the most critical arguments and problem-oriented awareness of the institutions and agencies involved. It became obvious, that the environmental engagement of the CVRD had already created a highly qualified specialised staff[108] and an active Brazilian advisory group, communicating with many foreign scientists and institutions.

As the government agencies involved in road construction and agricultural colonisation acted without any ecological awareness, CVRD emphasised a necessary social, ecological and economic zoning of its respective territories in Amazonia but remained isolated in the general PGC activities. CVRD had achieved a sort of coordination function between federal, regional, and municipal agencies of the most different functions, NGOs, universities, national research centres and international environmental organisations. It became clear that the CVRD Environment Department's flagship capacity should be strongly supported to promote diffusion of the know-how of an appropriate natural resources management (Kohlhepp *et al*. 1987).

However, CVRD environmental activities did not remain unquestioned. The Lagoa Batata problem at the Trombetas bauxite mining area (CVRD-subsidiary company outside the PGC-region), severe problems along the railroad line, difficulties in spatial planning coordination with unqualified local agencies, the domination of non-Amazonian specialists on the decision-level of management ("Minas Gerais lobby") and on the consultors' level can be mentioned. Universities and scientists in Amazonia reacted negatively to the exclusion of contracts for environmental studies.[109] However, the CVRD could not be held solely responsible for some of these problems, as they were

107 Environmental activities according to Freitas (1986, 24): Studies, consultants, dams, drainage, landscaping, hydrological measures, railway (hydroseeding, laboratory equipment), port (landscaping, purification plant).

108 During the international symposium "Homem e Natureza na Amazônia," organized by the author at the University of Tübingen in May 1986 with the participation of many Brazilian colleagues, the coordinator of the environmental department of CVRD, Maria de Lourdes Davies de Freitas, gave a conference on environmental strategies of CVRD in Carajás (Freitas 1987).

109 Contributions in: Almeida Jr. (1986), among others, in Belém and São Luís.

related to the centre-periphery structures in Brazil and had developed during the authoritarian regime of the previous military governments.

The extent of environmental protection procedures of the CVRD in the Carajás iron ore project went beyond the mere fulfilment of commitments in loan contracts to please the World Bank. However, it was clear to the CVRD management that without environmental measures, international loans could hardly be obtained. In contrast to many other cases in Brazil, CVRD activities in this sector were neither only "cosmetic" nor a pure publicity campaign. It is true that the CVRD used a lot of resources for glossy publications and information on different levels. However, it seemed to be necessary to start a new campaign of information on ongoing controversially discussed projects after two decades of failing information or keeping the public in the dark about problematic development processes. In fact, structural measures with a progressive approach to the problem and a new quality of science-based protection measures were realised.

However, it was obvious that the activities of CVRD's environmental department, which tried to reconcile ecological and economic goals, were also controversial within the company given the amount of money spent. This was to be expected given the very difficult situation on the international iron ore market and the following financial constraints. The support of top management and its room for manoeuvre on environmental issues in a mining company – with the federal government as the main shareholder – was certainly limited by the economic need to export iron ore and support the national budget.

But in the mid-1980s, it became clear that the big corporations had not expected such a well-structured opposition against mega-projects. The activities of NGOs with critical publications and protests in the now democratic Brazil showed that there was a high level of sensitivity and responsibility and a strong public interest in environmental protection in the Amazon region. Examples of this were the Society for the Preservation of Amazonian Natural and Cultural Resources (SOPREN) in Belém, which defined its organisation as "consciousness of the disregarded and oppressed regional population,"[110] or the National Campaign of Defence and Development of Amazonia (CNDDA) in Rio de Janeiro, which had a high scientific claim.[111]

This was a new experience for the decision-makers of large companies and state agencies. Discrimination by PGC officials against some well-informed NGOs as "anti-governmental" or "communist" was totally unjustified and complicated the interrelations.

Although the iron ore project in the Serra dos Carajás did not directly affect an Indigenous area, the CVRD as the responsible and in majority state-owned mining company became involved in the discussion on the future of the Indigenous population when the construction of the Carajás-railway was decided. This decision of the PGC Council – against Pará state interests and against ore transport on the Tocantins river – caused an 890 km traverse of the railway line mostly on Maranhão terri-

110 President of SOPREN, September 1986 in Belém.

111 Since 1967, the CNDDA, founded by Orlando Valverde, as an independent forum published the journal *A Amazônia Brasileira em Foco.* Members of this forum were renowned scientists like Aziz Nacib Ab'Sáber, Darcy Ribeiro, Warwick E. Kerr, Harald Sioli, Philip Fearnside, Irene Garrido Filha, among others. CNDDA organized conferences and protests.

tory and the crossing of some tribal areas. Because of previous alarming news from the Amazon region regarding the impact of development projects on the Indigenous population and in view of the increasing international concern as well as national and regional protests, the railway construction was combined with the recently reformulated strategy of Indigenous protection within the loans of the World Bank, one of the major financing organisations of the Carajás iron ore project. CVRD as holder of an US$ 304.5 million World Bank loan became increasingly confronted with "Indigenous affairs", originally the function of FUNAI.

The World Bank loan granted to the CVRD for the iron ore project came with special conditions for the Indigenous population. A number of US$ 13.6 million was separated to be used within five years in an area influenced by the construction of the railway line between Serra dos Carajás and the port of Ponta da Madeira. The World Bank emphasised the importance of minimising potential adverse impacts, of guaranteeing and protecting land and providing its demarcation to Indigenous areas and reservations. Furthermore, health care programmes, educational support, assistance in staff and infrastructure at the Indigenous posts and economic development projects were recommended. Given the inability of FUNAI, the money had to be directed via CVRD to FUNAI. In June 1982, the company and FUNAI made a special agreement on the World Bank loan.

Although the railway line only affected three Indigenous areas (Mãe-Maria, Caru and Pindaré, cf. Fig. 11) with about 820 inhabitants, the sphere of influence of "CVRD responsibility" was extended to eleven areas with an Indigenous population of 5600 people. The formal criterion of this spatial delimitation was a corridor of 100 km along both sides of the railway axis. This "area of influence" was considered sufficient by all institutions involved. However, in the activities to support the Indigenous communities, the focus on the mentioned areas proved to be impractical, as the inhabitants of other Indigenous areas outside the corridor felt strongly discriminated against. This extended the area of influence to 23 territories and an Indigenous population of about 11 500 people.

FUNAI had elaborated – necessarily in a very short period – a project of assistance to the Indigenous communities in the "railway corridor" without any scientifically based anthropological and ecological concern. The Indigenous tribes and their *caciques* were not informed of the PGC programme and its future consequences, they were not even consulted by FUNAI about the specific projects on their behalf. As FUNAI did not cooperate with renowned Brazilian experts and did not pay attention to the basic needs of the Indigenous groups, CVRD became aware that the financial means were used by FUNAI principally to improve its own infrastructure. FUNAI did not fulfil the basic lines of the agreement.

In view of the aggravating situation, the reactions of the afflicted people, the protests of national and foreign scientists, spontaneous protest movements and the negative international repercussion, the CVRD found itself compelled to intervene in the implementation of the Indigenous project. With scientific support of the Brazilian Association of Anthropology, important field studies were executed, and the real situation of the Indigenous tribes became well known. It was the first systematic analysis of the living conditions and the endangered existence of most of the Indigenous groups of Maranhão and southeastern Pará. The slow or even non-existing delimitation and

demarcation process of the Indigenous areas turned out to be the basic problem, urgently necessary to be solved.

Nearly all the well-elaborated proposals of the anthropologists were not taken into consideration by the FUNAI administration. In 1984, the government and CVRD decided to execute a direct supervision on the application of the World Bank financial means within the FUNAI expenses. It became clear that FUNAI was neither able nor qualified to solve the existing problems. For this reason, CVRD had blocked financial resources. As FUNAI had previously informed the Indigenous leaders about its extensive development activities, the Indigenous people protested against the non-fulfilment of promises.

The chaotic FUNAI administrative situation on the federal and regional level – certainly the Military Government had to be blamed for it – made it difficult to consolidate a new indigenist policy. In particular, the approach of participation of the Indigenous population in decision-making structures was never implemented by FUNAI. When FUNAI did not fulfil the contract priorities, CVRD proposed the suspension of the agreement and at least temporarily suspended the transfer of funds during a period of political transition in 1984/85. The situation of the Indigenous population along the railway line and in the PGC region will be discussed in more detail later.[112]

4.2.4. The infrastructural backbone of the CVRD iron ore project: Railway and port facilities

When the Carajás–Ponta da Madeira (EFC) railway line was inaugurated in March 1985, the earthworks and track construction, which were only possible for seven months of the year due to heavy rainfall, had taken more than four years. Extremely difficult natural conditions (Ab'Sáber 1996b) and the track crossing nearly 500 km of tropical rain forests caused enormous logistical problems. Track laying moved from the port to the mine at a rate between 1.1 km/day at the beginning and 1.9 km/day in 1984. Laying of the rails was associated with a tremendous forest devastation of several kilometers on both sides of the line. The railway was single tracked with 1.6 m gauge. About 43 passing turnouts were installed, 60 viaducts and the highly important 2.34 km railway-highway bridge crossing the Tocantins river at Marabá had to be built. The technical state of the railway and its infrastructure was supported by foreign expertise. At the peak of construction works about 20 000 workers were employed. Doubling of the track was planned for the period of an increase in iron ore transports and exports.

The ore trains with 160 cars and 98 t loading capacity each needed three diesel locomotives of 3000 HP each and a fourth at the highest point of the Serra do Gurupí (324 m above sea level). For the round trip mine–port–mine, 52 hours were necessary, i.e., 23 hours for the loaded train with a maximum speed of 65 km/h. Railway activity started with five to six ore trains per day (July 1987) (Kohlhepp 1987b),[113] about half of the Vitoria-Minas railway transport capacity at that period. Modern technical installations were supervising the railway operations, using remote control equipment for signals and line breakdown warning. Large areas at Ponta da Madeira and at Marabá were reserved for main repair and support installations. The railway transportation

112 See chapter I, 4.5.2.

113 For the current situation see chapter II.6.3.1.

system had been the most efficient in Brazil. Electrification was planned but postponed and not realized until today. General cargo transport, including agricultural products, was working as well as passenger service, increasing rapidly in 1987 to 350 000. Passenger transport by rail gained in importance, as fares were 30 % of bus fares and journey times were six hours shorter. This was a special CVRD service to the regional population. After initial fierce protests against the construction of the railway, it was accepted by the regional population.

Along the railway line, CVRD installed some small settlements (housing divisions) for permanent personnel stationed at the different railway yards. About 4000 people were living there with a perfect infrastructure, which caused irritation among the traditional local population. As the US$ 1.4 billion Carajás railway was the main transport axis of the state of Maranhão and a major attraction for migrants, a Master Plan of Regional Development was urgently needed. Land speculation, invasions by land grabbers, cattle ranchers, *posseiros* and related violent conflicts were constantly taking place or threatened.[114] Indigenous groups and *quilombolas* demanded that the federal government fulfil requirements related to the demarcation of the remaining lands.

The large maritim terminal was located at Ponta da Madeira on São Marcos Bay. The location on the island of São Luís about 9 km southwest of the capital of Maranhão and near the commercial port of Itaquí was favoured by very good natural conditions such as a deep-water approach. At the quay there was a water depth of 23 m. Tides reach 7 m, but the berthing pier was protected from tide currents by two breakwaters. The São Marcos Bay was wide enough for manoeuvring and anchorages of bulk carriers of 280 000 tdw and two-way simultaneous traffic of the largest vessels.[115] Docenave, the maritim branch of CVRD, operated a fleet of 26 ships, some of them among the most modern vessels. CVRD/Docenave reported numerous contracts by foreign shipping companies, some with ore-oil carriers, to transport Carajás iron ore to Japan, Europe and other destinations. The pier and ship loading equipment was financed by a German KfW loan. The installations at the railway terminal, the unloading capacity (1.30 hrs. for a 160-car train) and the stockpile area were planned for possible future expansion of iron ore mining, transport and exports. A pollution control plan was elaborated, aiming at restoration of vegetable cover, water and residual solids pollution control and landscaping. The ecological and socio-economic impacts of large projects in the municipality of São Luís are analysed in chapters I.4.4. and 4.5.

4.2.5. Pig iron and other metallurgical industries and the charcoal problem

Since the beginning of the PGC, the plan was not only to export the high-quality ores of the Serra dos Carajás, but also to use them in smelter sites along the central transport axis of the Carajás railway for the development of a regional pig iron and steel industry as well as other metallurgical industries. Although some pig iron projects had already been approved in 1986, there were no detailed studies on location factors, no evaluation of industrial sites, not to mention studies on ecological or socio-economic

114 See chapters I.4.5 and 4.6. Cf. SEPLAN (1989); Ab'Sáber (1996b).

115 In January 1987, the record embarkation was by the Norwegian ore carrier "Berge Stahl", at that time the largest worldwide with 365 000 tdw and built in South Korea specifically to transport Carajás iron ore from Ponta da Madeira (CVRD, *Jornal da Vale*, January 1987).

impacts. Even the CVRD complained about a complete lack of coordination and information by the PGC in relation to these projects.

The basic problem was the supply of charcoal, used in large quantities as reduction material in the smelting process. In the mid-1980s it became increasingly clear that the very optimistic calculations and projections for massive afforestation were not feasible, not only for ecological reasons, but also for economic and organisational reasons (Fearnside 1989b and 1989c; Almeida Jr. 1986; Monteiro 1998). As the environmental and social consequences of charcoal production are by far more important than the direct pollution problems, the impacts should have been thoroughly discussed. It was assumed that charcoal production would require an area of about 15 000 km², and huge afforestation areas with fast-growing species were planned. This indicated that no transfer of knowledge occurred in view of the well-known ecological problems of large-scale monocultural plantations in the humid tropics. According to previous experience in Amazonia, from the Ford plantations with *Hevea brasiliensis* in the Tapajós region to the large reforestation operations in the Jarí project with *Gmelina arborea*, *Pinus caribaea* and *Eucalyptus*, reforestation planning in the PGC region was not only superficial but without any scientific approach.

According to PGC information and a report of CODEBAR/SUDAM (1986), 11 projects, incl. seven pig iron plants approved in May 1986, would need 1.1 mt of charcoal. The pig iron plants planned at various locations along the Carajás railway were to produce 1.68 mt of iron annually. Based on a charcoal consumption of 3.2 m³ per ton of pig iron, the total demand of charcoal in the PGC region would amount to 5.4 million m³/year. It should be recalled that Brazilian charcoal production through reforestation amounted to 1.61 million m³ in 1984.

As previous calculations of the reproduction rate per hectare in plantations had been far too optimistic, the *Eucalyptus* area needed for the planned pig iron production would be no less than 26 000 km². According to Fearnside (1988), the area potentially needed for reforestation exceeds the Jarí plantations, the largest reforestation area in Amazonia, by a factor of 35, making it almost as large as Belgium. This showed that an afforestation area of this size would be ecologically extremely irresponsible and could not be adequately managed. The PGC afforestation planning had a delusional vision. But even if taken seriously, where in Eastern Amazonia could afforestation areas of this dimension be located for charcoal production in a pig iron industry starting in 1988/89?

A comparison with the state of Minas Gerais, where 84 % of the Brazilian charcoal production (99 % from *Eucalyptus*) from reforested areas were located, proved that this amount was only 25 % of the total consumption of charcoal, the other 75 % being supplied from natural forests with widespread degradation effects. In 1986, reforestation in Minas Gerais covered one million ha. 70 % of the costs of pig iron production came from charcoal production, the range of supply surpassed 500 km, already expanding in neighbouring states. As charcoal supply to the Minas Gerais metallurgical industry would become even more difficult in the near future, industry and large charcoal suppliers were looking for an alternative in the Amazon area (Ab'Sáber 1987). As the transport of charcoal from there to the traditional sites in Minas Gerais was not economically viable, new industries were established in the PGC area based on the regional charcoal supply. Considerable financial interests of Minas entrepreneurs were involved.

As there was no reforestation in the PGC region, the planned industrialisation relied on charcoal production from the tropical rain forests.

Superficial maps – actually sketches – did not refer to natural vegetation conditions or land use. Some of the mapped potential supply areas coincided with *cerrado* areas or even with completely deforested areas with extensive pastures (Valverde 1987). The idea of charcoal supply from strips or corridors along the roads was inviable because forests along the main roads already had been totally destructed, sometimes in "corridors" more than 50 km wide. Furthermore, Indigenous areas and reservations were simply included into the potential supply area. Charcoal production threatened to lead to an onslaught on remaining rain forests, resulting in the ecological collapse of these ecosystems and an alarming increase in conflicts of interest.[116] There was an immediate risk that many industrial projects would organise charcoal supply with subcontractors, as this was the "normal" way to avoid social and environmental implications.

In view of these problems, the use of *babaçu* husks as an alternative for charcoal production was discussed. In the Meio Norte region of Brazil, the natural vegetation of babaçu palm forests (*Orbignya spp.*) was widespread (see Fig. 11), and the use of the husk (*endocarp*) of the *babaçu* fruit was a suitable method to take advantage of the annual regeneration cycle of the fruit. The *endocarp* is composed of nearly 25 % of fixed carbon with excellent quality for charcoal. But there was a restricted know-how of the technical procedure of *babaçu* husk charcoal in smelting. A pilot-plant in Teresina (Piauí) was closed and the Ministry of Mining and Energy had officially desisted from using *babaçu* charcoal. This meant that resuming the use of *babaçu* husk did not guarantee a regular and quantitatively sufficient supply.

However, the most important reasons against large-scale use of *babacu* charcoal in industrial projects were social implications. In Maranhão, *babaçu* palms constitute a very important natural resource, providing cash and subsistence benefits to more than 350 000 peasant families. Traditionally, land for shifting cultivation and *babaçu* palms for extraction activities had been provided by landowners under informal contracts, permitting peasants to live on their property in exchange for in-kind rents and a stable labour supply. Besides cash income from breaking the fruits and selling kernels, *babaçu* palms provide numerous products such as edible oil, feeds, materials for basket-making and finally charcoal, used mostly for private cooking.

In recent years, economic interests of large landholders increasingly changed to mechanized agriculture and expansion of cattle ranching. Both activities severely interfere with the cash and subsistence needs of the landless peasants because *babaçu* stands were eradicated. The public discussion on land reform after the end of the Military Government additionally caused intense pressure on rural families because of limited access to land by fencing of large properties and displacement of peasant families. Violent actions had rapidly increased.[117] In this situation, even tendencies to

116 Charcoal production and its environmental and social impact were a central topic for Brazilian researchers, especially from the Amazon region, and foreign colleagues. Cf. Pinto (1982); IBASE (1983); Almeida Jr. (1986); Castro (1989); Castro and Hébette (1989); Hébette (1991); Andrade (1995); Monteiro (1998) ; Valverde (1987; 1989); Ab'Sáber (1987; 1996b); Fearnside (1988), among others; Fearnside and Rankin (1985); Kohlhepp (1987b); Kohlhepp and Schrader (1987); Kohlhepp *et al.* (1987). See also: IDESP (1987).

117 Cf. chapter I.4.5.

stimulate the use of *babaçu* products for charcoal production would have caused disastrous social consequences.

As a result, the ecologically most favourable alternative, the charcoal production from *babaçu* husks, turned out to be socially irresponsible and politically and even economically impracticable (Kohlhepp 1987b; Kohlhepp *et al*. 1987).

According to forest legislation, every charcoal consumer must own 50 % of the area needed for charcoal production. A reforestation plan had to be prepared for this area, with details of the deforestation cycle. If this was indeed the case – and the doubts were justified – it would create tendencies to enlarge landholdings. Since reforestation was not possible in the short term, charcoal production from natural rain forests remained the only option for supplying the pig iron and metallurgical industries.

Numerous charcoal kilns in batteries of 10 to 20 units had already been built along the highway axis. Although the kilns in the past had been favourably located as far as transportation was concerned, in 1989 they were moving more and more to keep up with the shifting locations of raw materials. As the trees along the main and secondary roads were cleared, the kilns moved deeper into the forests[118] (Fig. 14) and the access roads were widened. In the Marabá region there had already been demonstrations against the destruction of the valuable *castanhais* – self-contained stands of the Brazil nut tree (*Bertholletia excelsa*). For this reason, the sites of the kilns have been relocated also for tactical reasons. Furthermore, landowners perfectly knew about the new environmental legislation and were not keen on being confronted with IBAMA agents. The side roads could not be used without permission from the *castanhais*' owners so that the covert production of charcoal frequently escaped the notice even of government inspectors. Sometimes their mobility had been restricted by direct or indirect intervention of the owners.

According to the estimation of the president of the Syndicate of Rural Workers in 1989, the number of kilns in the micro-region of Marabá was between 2500 and 3000.[119] Due to the uncertainty of how to deal with the charcoal problem, given the conditions of forest legislation and increasing public pressure, some landowners of *castanhais* and rain forests with different vegetation composition behaved aggressively.[120] The syndicate's president, who protested against the conditions of workers in kiln construction and charcoal production, was threatened with death and had to leave the region several times for security reasons. Official information about charcoal production was vague and statistics tried to hide lacking studies. There was an overall need for research. Planning was partly unrealistic and charcoal suppliers were not sure about the success of the approved pig iron projects. In official documents, the use of Brazil nut trees for charcoal production was denied but could be proved at many locations.

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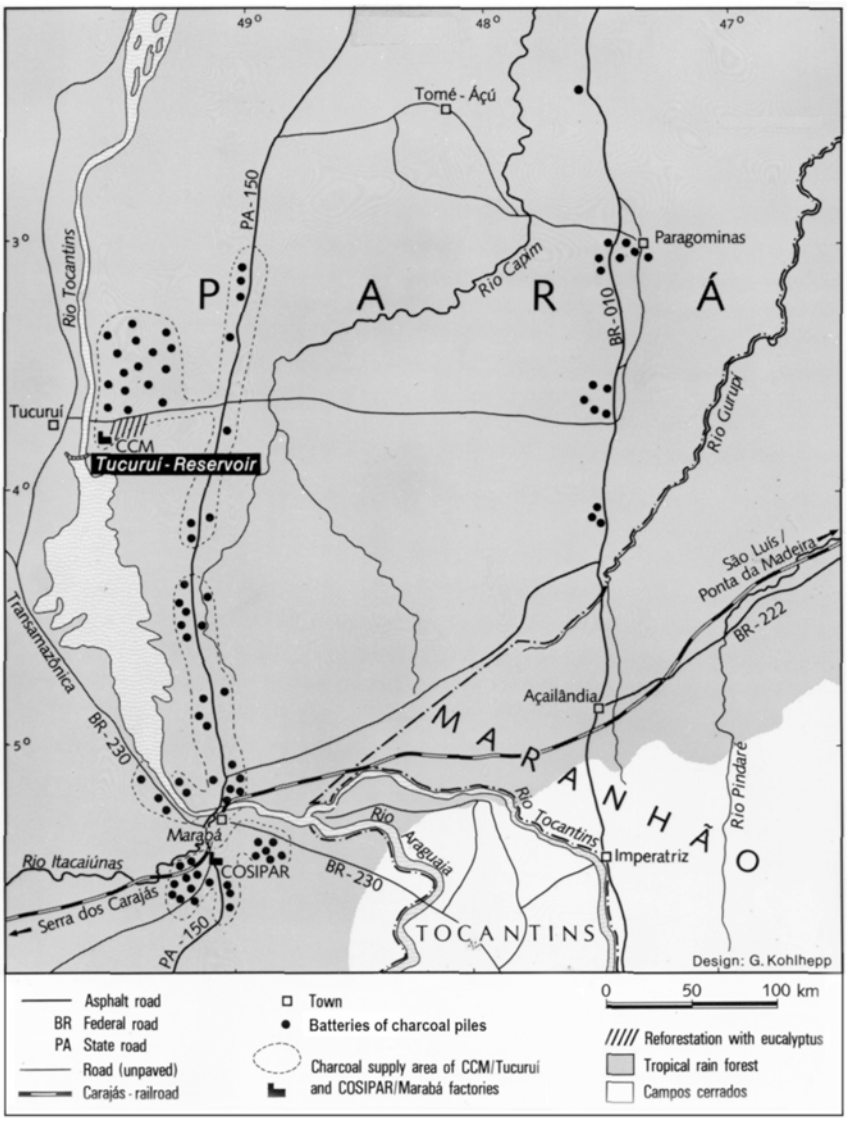
118 In October 1989, the author did field work in the region of Marabá with numerous interviews with owners of *castanhais*, workers at charcoal kilns and the president of the Syndicate of Rural Workers of São João do Araguaia, Sr. Almir Ferreira Barros.

119 In March 1994, there were 311 charcoal kilns operating in the municipality of Jacundá/PA alone (Monteiro 1998, Table 8, 140 f.).

120 The author's mapping of charcoal kilns and taking photos of Brazil nut trees felled was not only refused but was violently prevented. The wood was immediately processed into charcoal on site. *Pistoleiros* of landowners stopped interviews and the use of side roads. Fortunately, a detailed photo documentation could be realized by the author.

Fig. 14: Location of charcoal piles in the area Marabá–Tucuruí–Paragominas 1989



Source: Cf. Kohlhepp (1989a, 96; 1991a, 97); based on IDESP (1988) and own field work information and mapping.

In charcoal kilns mapped in October 1989, high-quality timber was used almost exclusively, frequently including *Bertholletia excelsa* in the immediate surroundings of Marabá. Other species were Jatobá (*Hymenaea courbaril*), Angelim (*Hymenolobium*), and Massaranduba (*Manilkara*). Some of the best trunks were sold to sawmills or bought by timber trade, such as mahogany (*Swietenia macrophylla*). Some *fazendeiros*, who only sold mahogany, burnt down the rest of their forest property and switched to pasture and cattle breeding. Only at a few sites along highway PA-150, mainly wood waste from

sawmills was used for charcoal production. Some years later, in 1994, the number of kilns using wood waste from sawmills had increased (Monteiro 1998).

At the beginning of the main charcoal production period, the first kilns were built in 1988 with the know-how of the suppliers in Minas Gerais according to a simple design. Bricks came from Marabá where many brickyards were located. Workers for forest clearing and charcoal production were contracted in Bahia and Espírito Santo. They came in groups of four to eight men and worked under inhuman conditions. Kiln construction was made in one day by four people, earning 10 NCz. (= 2.7 US$)[121] per person/day. Kilns are 2.2 m high with a diameter of 3 m. The workers stayed without any infrastructure in the forest, complaining about lack of water and adequate food, failing social security, lacking support in case of frequent diseases such as malaria and other infections. They were suffering under permanent smoke of the kilns and were responsible for the sequence of all operations until charcoal production.[122]

One kiln filled with timber needed one week for producing 1.5 t of charcoal. Sometimes, working in family groups was realized. They had to attend 16 kilns, i.e., producing 24 t of charcoal per week. With moist wood, the average production per week was about 20 % lower. The example of one battery of kilns: The workers were paid 15 NCz. (= 4 US$) per ton of charcoal. The group of six people earned 360 NCz. (= 97.3 US$) per week.[123] The owners of *castanhais* had lorries to transport the charcoal to the consumer. They gained 230 NCz. (= 62.2 US$) per ton of charcoal, i.e., 5520 NCz. or 1492 US$ for the weekly load of 24 t of charcoal. For an intermediary who organized the work power they paid 25 NCz. per ton of charcoal, i.e., 600 NCz. Net earnings – without considering lorry transport – amounted to weekly 4920 NCz. (= 1330 US$) per battery of kilns. Most of the owners of *castanhais* had several batteries of kilns working. They had a very good profit.

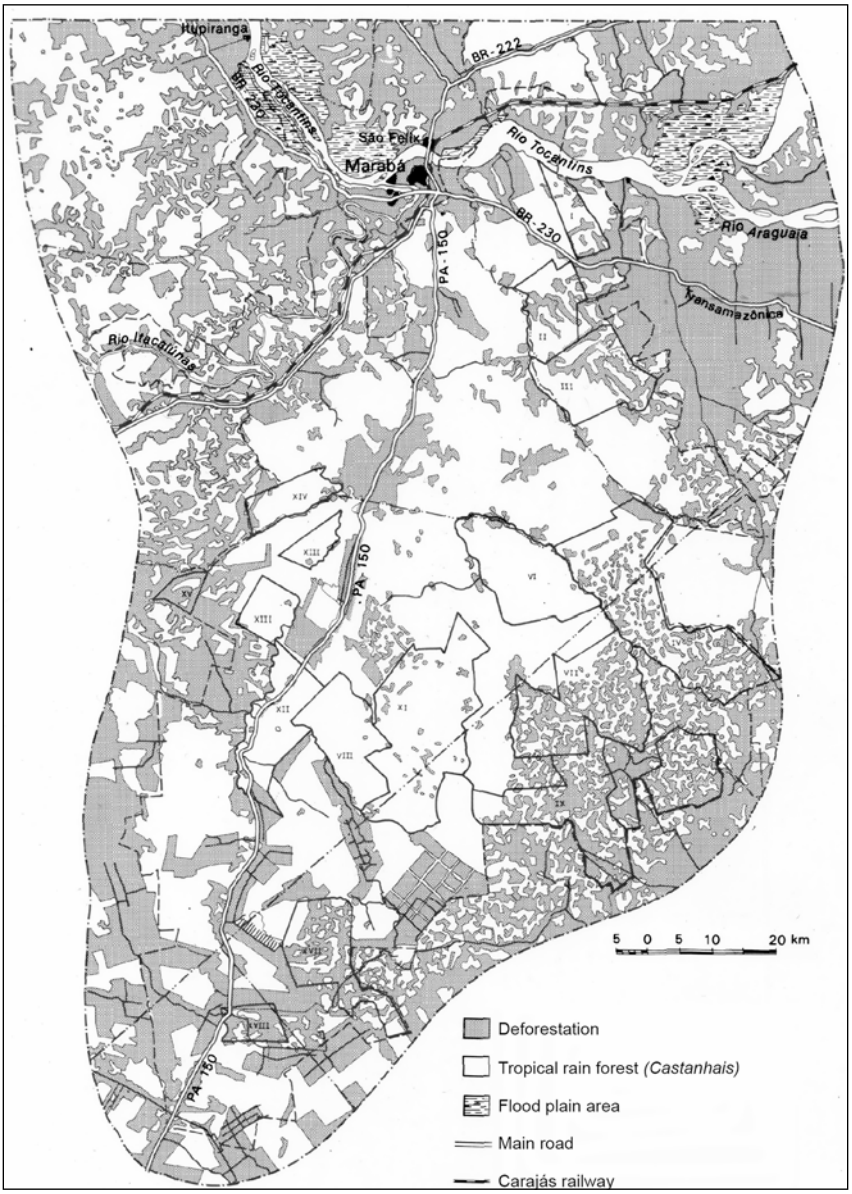
Among the owners of *castanhais* were several members of the Mutran families from Marabá, who had good political connections and were originally from Maranhão. They were traders in Brazil nuts, exporters of precious woods and had recently turned to the production of charcoal, subsequently using their deforested land for cattle breeding. The *castanhais* near Marabá had an area of 5000 to 17 000 ha each. Deforestation occurred rapidly and the destruction of *castanhais* contributed to the collapse of Brazil nut trade and poor rural peoples' earnings for fruit gathering, the traditional economic activity in the Marabá region (Kitamura and Müller 1984). In June 1990, in a region of 1.7 million ha 44.6 % of the area had been deforested (Fig. 15). Forest fires often left a haze over Marabá, schools had been closed and protests by the population remained ineffective.

121 Conversion rate of currencies: 02.10.1989: 1 US$ = 3.7 Cruzado Novo (NCz. official rate; tourist rate: 7.5 NCz.).

122 Some years later in 1994, Monteiro (1998) observed several types of wood supply and charcoal production with specific interrelations between sawmill owners, supply of wood, construction of kilns and delivery to the pig iron industries.

123 Data obtained by interviews in the Marabá region in October 1989. The regional minimum salary per month per person in October,2 1989 was 260 NCz.(= 70.3 US$).

Fig. 15: Deforestation of castanhais *in the Marabá region (Pará) in June 1990*



Source: Author's design; Map 1:250 000 elaborated by IDESP, SUDAM, DRN, June 1990: Polígono dos Castanhais: Real estate and forest situation.

As far as the supply of charcoal was concerned, there was complete confusion about the future planning of a quantitatively sufficient and ecologically appropriate supply. Plans to use wood from the Tucuruí reservoir were discussed but could never be realised. It would have been much better to do it before the reservoir had been flooded. Charcoal prices ranged from US$ 40–50 for charcoal made from sawmill waste to over

US$ 80 for charcoal from plantations (probably mainly *Eucalyptus*), which in reality existed only in some small model plantations. As already mentioned, the plantations should have been established earlier to comply with the new environmental regulations. Charcoal from the *roça* of the peasant plots was neither available in large quantities and on a permanent basis, nor was it produced efficiently in the required quality. It was unclear how a permanent supply could be organised during the main rainy season, as many access roads were impassable and the kilns remained inaccessible.

Large areas of tropical rain forests were cleared to meet the charcoal needs of the pig iron industries. The area of forests destroyed depended on the planned scale of industrial production. According to statistics from PGC in October 1989, 5.9 million m^3 of charcoal (= 1.48 mt) per year would be needed to supply the 19 plants which had been approved. The production planned was calculated in 1.36 mt of pig iron and 220 000 t of alloys. The discrepancy in the calculations of the forests to be cleared for charcoal production was enormous. Contrary to PGC data (455 km^2 to clear annually), experts[124] estimated that the annual area cleared would amount to 1000 km^2 or up to 2200 km^2, depending on the biomass and the density of the forest stands, in order to meet a target production of 2.8 mt of pig iron announced earlier by PGC. In October 1989, only four pig iron plants – two at Marabá, two at Açailândia – had already started production. IBAMA's demands that the iron ore plants ensure a consumption of 70 % of charcoal from reforestation by 1992 and reach 100 % by 1995 were systematically disregarded from the beginning. José Lutzenberger, the State Secretary for Environmental Affairs of the new Government of President Collor de Mello, made a clear statement in 1990 to stop pig iron and charcoal production activities in case of disrespected legislation and in order to prevent further expansion (Kohlhepp 1991a).

However, it was clear that charcoal from plantations (*Eucalyptus*) would not be competitive for economic reasons. In 1989,[125] the costs of charcoal amounted to 83 US$/t, with additional transportation costs and handling costs of 15 US$/t of pig iron and 7.5 US$/t iron ore costs. Export prices of pig iron run up to 128–130 US$/t. On the other hand, charcoal produced near the consumer's plant by direct logging of the primary forest was traded at US$ 30.7/t, free smelter, i.e., including transport costs.[126]

This was proof that pig iron production was only profitable through destructive overexploitation of virgin forests and the merciless exploitation of labour force. All the economic actors involved, planning officials, representatives of public authorities and private entrepreneurs, had not considered the environmental and social costs that will force the state to invest far more in the medium and long term to repair the damage caused by the unscrupulous exploitation of natural resources and labour.

The only solution to the problems created by destroying rain forests would be to import coke or using electric blast-furnaces, supplied with energy from the Tucuruí hydroelectrical power station. However, given the world market price for coke (130 US$/t, corresponding in 1989 to the price of one ton of pig iron) these solutions could work only if highly subsidised, probably exclusively from international financial sources,

124 Hearings of international experts in the German Parliament in May/June 1989 (Deutscher Bundestag 1990; Valverde 1989).

125 Information provided by PGC during an interview with one of the managers on October 2, 1989 in Marabá.

126 Interviews of the author on October 4, 1989 near Marabá.

e.g., in the form of "debt-for-nature-swaps". Importing coke would only be worthwhile for the production of ferroalloys, whose retail prices were 10 to 15 times higher than those of pig iron.

The establishment of pig iron industries in Açailândia and the Piquiá railway station there was questioned, as one of the main reasons was the availability of land in Piquiá that was already upgraded by existing infrastructures and owned by the project promoters (Valverde 1989). The hydrographic conditions were not suitable for a high-water demand for the plants mentioned. A direct site at the bank of the Tocantins river, the railway passing nearby, would have been much better.

The economic viability of pig iron projects had been questioned by the National Council of Metallurgy (Consider), classifying pig iron plants with a capacity of less than 1 mtpy as uneconomical. The projects approved had a total production capacity of only 1.1 mtpy, creating 2100 jobs. Five plants had only a capacity of producing between 50 and 55 000 t. This enormous discrepancy in production could not be explained by PGC officials. Pig iron production along the Carajás railway could only be competitive against production in other regions of Brazil (1984: total production of pig iron on charcoal basis 6.2 mt; 92 % in Minas Gerais) with high tax incentives and other benefits granted. FINAM (Investment Fund of Amazonia) funds had been very important.

The number of projects submitted and approved has been very unreliable. Of the 15 pig iron projects planned by the PGC for Maranhão, only 6 were realised and commissioned in 1996, some with long delays. The location of five enterprises was in Açailândia with an individual production capacity between 50 000 and 170 000 t/y, one was located in Rosário (start in 1992) (IDESP 1988; Monteiro 1998). The concentration of pig iron industries and the pollution caused by charcoal kilns in later years led to enormous protests and to the resettlement of a part of the Piquiá population.

Only three projects had been realised in Pará. Two pig iron industries in Marabá (see below) and a metallic silicon production in Breu Branco, 5 km distant from the Tucuruí power plant. Near Tucuruí, Brazil's largest construction company Camargo Corrêa started in 1986 the installation of an industry producing metallic silicon (CCM). The primary location factors were availability of electrical energy, nearby deposits of quartz sands, regional charcoal supply and wood chips from the primary rain forests and own reforestation. A very important factor was the company's infrastructure at Tucuruí, especially heavy machinery, used at the dam and powerhouse or residential areas construction. Tax incentives had been granted to Camargo Corrêa S.A. The company had diversified its activities in the primary and industrial sectors considerably. In the 1980s, the company acquired, among other things, 35 % of the share capital of Alcoa do Brasil.

CCM started with its first blast furnace in April 1988, three other blast furnaces – with support of German industries – were to be installed in the following years with the employment of 600 workers. The total capacity of metallic silicon planned was 36 000 tpy. At that time, this was 12 % of the world's production and 60 % more than the Brazilian output in 1983. 50 % of the charcoal demand (54 000 tpy) were planned to be supplied by company-owned *Eucalyptus* plantations of 35 000 ha, with first results of logging after 6 years. According to CCM staff calculations, 700 charcoal kilns would be needed for supply during the maximum production.[127]

127 Interview of the author with CCM staff on September 15, 1986.

In 1996, 76% of the pig iron production (0.7 mt) along the Carajás-Ponta da Madeira railway was exported. During the first years of production (1988-1995), Açailândia concentrated 66% of the production, Marabá participated with 27% and Rosário (since 1992) with 7% (Monteiro 1998, 99, Table 3; % calculations by the author).

In 2004, the production of pig iron in East Amazonia amounted to 2.96 mt and 3 mt of charcoal were needed for supplying the production. Large areas of tropical rain forests have been destroyed by clearcutting. This process of devastation will continue with the increasing pig iron production, lacking forest management and insignificant reforestation activities. Only 4.6 mt of iron ore (= 6.6 % of the iron ore mined at Serra dos Carajás in 2004) were consumed by the regional pig iron production (Monteiro 2005, 160).[128]

Case study: Marabá in the 1980s

The regional centre Marabá (1989: 125 000, 2022: 266 400 inhabitants) at the confluence of the Tocantins and Itacaiúnas rivers started the installation of an industrial district with an area of 3000 ha in 1988. The location had a good infrastructure with railway connection and electricity from the near Tucuruí hydroelectric plant. In 1981, the Itacaiúnas bridge had been built and in 1985 the important bridge over the Tocantins river for railway and road traffic had been inaugurated. Although it was an important transport hub, the road connections to the Belém–Brasília highway via the Transamazônica (BR-230) and the direct connection to Belém (PA-150) were not yet asphalted. Road traffic conditions were very bad. With the construction of the Tucuruí dam, possibilities for river navigation were studied. The transport alternatives of the Carajás railway to São Luís – besides the better port facilities for iron ore shipping and the existing know how in transporting bulk goods by railway – had also a political background because of better relations of the Maranhão state government to the federal decision level.

Marabá was conceivably unsuitable for a heavy industry site from a climatic and ecological point of view. The allocation of rain forest land for the settlement of industrial enterprises was done through non-transparent "donations" without any preliminary studies of the environmental impact and the explosive social situation. The industrial district was established by the state of Pará, financed by CVRD. The local elite of leading families valorised their land by establishing industries (Ab'Sáber 1996b).

In the industrial district of Marabá, the Itaminas Group from Minas Gerais, the largest pig iron producer in Brazil, invested in September 1989 in a pig iron plant (Cosipar) with a capacity of 120 000 tpy (IDESP 1987 and 1988; Monteiro 1998). The company complained about difficulties with local manpower. All specialists came from Minas Gerais. The charcoal problem was dealt with with extreme caution and not discussed in detail. Brazilian producers were the only ones to use charcoal as a reducing agent for ferroalloys and metallic silicon on a large scale. In the mid-1990s, the price of charcoal averaged 44–60 % of the price of pig iron (Monteiro 1998, 133).

A second pig iron industry (Simara) in the new industrial district of Marabá was started in 1988 but had to stop production for a few years due to problems with the blast furnace and was only restarted in 1995.[129]

128 For the latest development of the Marabá industrial district, see chapter II.6.3.1.

129 Large project plans of pig iron (1.5 mtpy) with Tjaspromexport of USSR, planned to be located in the industrial district of Marabá, and a ferro manganese production, probably in Parauapebas, were not realized.

At the height of production in Marabá, the pig iron sector employed 8000 direct workers and around 36 000 in the entire production chain. However, the economic crisis of 2008 had a disastrous effect on the industrial district of Marabá, Not even 3000 direct jobs remained. The Cosipar steel plant, the first steel works in Marabá, closed. There were two major unresolved issues. The first was the price of the iron ore supplied by Vale and the second concerned charcoal of legal origin, which remained very difficult to obtain. To date, there is no clear afforestation policy.[130]

Traditionally, Marabá was the centre of trade in Brazilian nuts. Marabá was confronted with modern development strategies when the Transamazônica was built in the early 1970s, passing by Marabá. Camps of road construction workers, agrarian colonisation activities, administrative necessities and SUDAM-sponsored large cattle ranching projects in the surroundings turned Marabá during the 1970s to a sort of basic logistical centre. Marabá also suffered from inundations, the most disastrous in 1980.

The town was divided in three parts: Velha Marabá, the traditional old town, directly at the point of confluence, with the commercial centre and most of the residential quarters, the "cidade do povo". This part was severely affected by flooding, but the population refused to be resettled.

Cidade Nova: Since 1957, some quarters arose on the left bank of the Itacaiúnas river, south of Velha Marabá. This area became the quarter of the social middle and upper class.

Nova Marabá: This was the planned new town, east of Velha Marabá on a *terra firme* site. By order of SUDAM, an ultra-modern urbanisation concept with leaf-like spatial structures has been developed. This large district was very poorly connected to the rest of the town. It was the residential area of the poor population, who also settled on the flood-prone terrain.

Marabá became a prime example of Amazonian urban planning that neither met the needs of the majority of the population nor in any way took into account the social and urban-climatic proposals of Brazilian scientists who considered the specific local environmental conditions, social tensions and urban-rural relations (Ab'Sáber 1996b, 98–102; Kohlhepp 1987b; Kohlhepp *et al*. 1987).

With the construction works of the Carajás iron ore project and *garimpeiro* activities in nearby Serra Pelada in the 1980s, Marabá was overwhelmed by fundamental changes in functional and physiognomic structures. Large construction companies, the CVRD and official agencies, subcontractors and others transferred their subdivisional headquarters to Marabá.

In the 1980s, Marabá suffered from an exceptional migration of mostly unskilled workers, causing increasing population pressure in the infrastructure of all sectors and widespread invasions in Nova Marabá and Cidade Nova with all its negative consequences. Land speculation inside the urban area paralysed systematic urban planning. Rents and living costs exploded. *Garimpeiros* returning from Serra Pelada and other *garimpos* made Marabá a pioneer town with an intensive flow of capital, but extreme poverty of the absolute majority of the population and a high crime rate. After the end of construction work in Tucuruí, thousands of labourers (*barrageiros*) came to Marabá. Huge favelas spread in and around the town. In Marabá there was an adventurous mix of different

130 For today's situation see chapter II.6.3.

social groups with mostly conflicting interests. The new industrial district that emerged at the end of the 1980s attracted a new wave of migrants looking for jobs, directly or indirectly. However, the large majority remained in a desperate situation and unemployed.

As the large municipality of Marabá was very poor, the new industrial projects, including the Parauapebas site, confronted the municipal administration with almost insoluble problems. Town population, budget, infrastructure on all levels were not prepared for the shock to come. Unrealistic structures of administrative competence, lack of coordination and of considering social and environmental costs of development planning were inherent in all large projects. The municipal administration was not integrated in planning and executing procedures. The former authoritarian planning structures were not adapted to the new democratic reality. The ecological and social impacts burdened a development process that, as "development from above", could not be adjusted in time to the regional conditions and the mentality of the local population. As mentioned above, large-scale deforestation of tropical rain forests occurred without any perspective of reafforestation which was not viable ecologically and economically. Illegal logging of remaining primary forests for the production of charcoal for the regional pig iron industry continues to this day (Greenpeace 2013). Today, Marabá is a conurbation with difficult problems of social segregation.

4.3. The hydroelectrical power plant Tucuruí: Environmental and socio-economic impacts

4.3.1. Regional hydroelectric potential and Tucuruí project data

The hydrographic basin of the Tocantins-Araguaia rivers in East Amazonia covers an area of 767 000 km². The hydroelectric potential is estimated at 25 000 MW, i.e., 12 % of the Brazilian total. The two parts of the basin have very different geomorphological characteristics so that the Tocantins with its higher gradient and its higher drainage density concentrates 80 % of the potential and the larger part of the 27 dams proposed to use the total potential of the Tocantins-Araguaia basin.

As the Amazon region is an enormous sedimentary basin with only smooth relief forms, the installation of dams and very large reservoirs was necessary for using the hydroelectrical potential. This meant flooding huge rain forest areas. There was an extremely controversial discussion in Brazil on the government's strategy to implant large powerplants in the Amazon region, particularly because of ecological and socio-economic impacts as well as high financial investments.

Already in 1973, Eletronorte had been created as a regional electric power company, controlled by the head office Eletrobras, to study the hydroelectric potential of the Amazon region and to conduct feasibility studies of implanting power stations in this region. The regional development strategies of the Brazilian Military Government favoured large-scale projects with a high capacity for industrial supply.

Tucuruí was the corner-pillar of this economic development strategy. Located at the Tocantins river, downstream the confluence of the Araguaia and Tocantins rivers, about 200 km north of Marabá and 300 km southwest of Belém, the powerplant Tucuruí was the precondition for all industrialisation programmes, particularly for the decision to

concentrate large aluminium producing plants in East Amazonia.[131] As Tucuruí is located in the middle of a tropical rain forest region, there were very few examples that were directly comparable and whose impacts were transferable to the case of Tucuruí, e.g., Brokopondo in tropical Surinam. In Brazilian Amazonia, Tucuruí was only preceded by two small reservoirs: Curuá-Una near Santarém, and Paredo in Amapá.

Construction began in 1975 and an environmental impact analysis was carried out (Goodland 1978). In 1986, Eletronorte published the following data on the project:

The first stage of the project had a final capacity of 4000 MW, with 12 main units of 330 MW and two auxiliary units of 20 MW.[132] In 1986, Tucuruí had the fourth rank world-wide in generating capacity of hydroelectric plants, at that time Itaipú being the leading plant (12 600 MW). The Tocantins river has an average river flow of 11 000 m^3/s, the minimum flow registered was 1511 m^3/s, the maximum flow observed was 68 400 m^3/s. The spillway flow had been prepared for 100 000 m^3/s.

The inundated area of the Tucuruí reservoir at maximum level (72 m above sea-level) is 2430 km^2, the second largest in Brazil (Fig. 16) (as a comparison: Lake Constance/Germany: 538 km^2). The Tocantins river was dammed up nearly 200 km, the length of the reservoir is about 170 km, width on an average 14 km, maximum width 40 km. The total accumulated volume of the reservoir is 46.8 billion m^3, rank three worldwide at that time. Crest level of the dam of about 7 km is 78 m. Concrete structures of about 6 million m^3 had been installed. The first two units were commissioned at the end of 1984. At that time, the cost estimates with financing costs were US$ 5.5 billion for the first stage, including transmission lines.

The information on the cost of installed kW varied considerably in the various Eletronorte publications: US$ 879/kW versus 696/kW for the first stage (June 1986). During the construction of Tucuruí, the possible installation of two locks was considered. Since the decision to transport iron ore to Ponta da Madeira by rail had already been taken some years earlier, in the mid-1980s there were still discussions about transporting agricultural production in the Tocantins-Araguaia Basin to Belém by riverboats. Until 1984, work on the locks progressed normally, but then slowed down due to a lack of funds and finally came to a halt in 1989. However, the possibility of also using the railway connection to São Luís for rural products made the realisation of the lock facilities seem not very likely.

The Tucuruí transmission network is of utmost importance for the industrial development of the region. 500 kV transmission lines were installed for a total length of 1930 km from Tucuruí to Vila do Conde (Albras/Alunorte industries) and Marabá–Imperatriz–São Luís (Alumar), as well as 510 km of 230 kV transmission lines and 11 switching stations. Interconnections with the CHESF grid in the north-east of Brazil were in place.

Compared to other hydropower projects under construction in Amazonia, the ratio of power generation to flooded area in Tucuruí was favourable at 3.3 MW/km^2. In Balbina, north of Manaus, this factor was 0.1 MW/km^2 and some African power plants also had very low values (e.g., Lake Volta, Lake Kariba). On the other hand, Itaipú was proud of a ratio of 9 MW/km^2 due to its unique natural conditions with the Rio Paraná canyon (Kohlhepp 1987c).

131 Cf. chapter I. 4.4.

132 The second stage (Tucuruí II) started in 1998 and the installed capacity today is 8370 MW.

4.3.2. Environmental problems of large reservoirs in the tropics and the Tucuruí situation

Already in the discussion of the 1970s about the importance of hydropower, the licensing authorities and operators often referred to this energy production as "clean energy," in contrast to fossil fuels. It was deliberately concealed that greenhouse gases are emitted on a large scale, especially in tropical forest areas where the forest vegetation in the reservoir area is not cleared before flooding. In an ecological perspective, the main problem was the process of anaerobic decomposition of biomass in the flooded area of the reservoir, the emission of toxic greenhouse gases (CO_2, H_2S, methane – CH_4) from decay of trees left standing in the reservoir. Effects on the pollution of the biomass parts in the turbines, on the water quality and especially on the oxygen content could be observed. With the decomposition of the organic material, the unpleasant smelling gases decreased, but in September 1986 the problem could still be detected in Tucuruí.

In addition to the CO_2 emissions of the reservoirs, the emissions of the construction work must also be included. Extensive earthworks with heavy machinery, deforestation in and around the construction site, enormous heavy goods traffic over years to transport the materials, dam and power plant construction burden the CO_2 balance. In relation to the use of fossil fuels in energy production, this is only compensated for decades later. The Tucuruí dam showed that the actual greenhouse gas emissions were a factor ten higher than its official calculations showed. In 1990, Tucuruí had a global warming impact greater than that of the fuel burned by the city of São Paulo (Fearnside 2002, 21).[133]

Tucuruí was an example of the lack of coordination of measures to remove and use timber in the flooded area. The very different estimates for the total timber volume of the Tucuruí reservoir area varied between 2 and 13.4 million m³. Due to a dispute within the government over the awarding of contracts to companies supported by different ministries, the time available for the start of timber removal was short. Almost 50 % of the wood potential of the reservoir was the valuable Brazil nut tree (*Bertholletia excelsa*). Although the contracted company Capemi was granted the privilege to commercialise these timber stands, deforestation operations remained unsuccessful. The company was not equipped with efficient machinery, had no experience in deforestation and finally went bankrupt in 1983 after clearing only 0.5 % of the submergence area (Fearnside 2001a, 381). Fraud and corruption were strongly suspected. Only 140 000 m³ of timber could be removed in an area of only 30 km² and half of this timber was sold (Kohlhepp *et al*. 1987). In addition to the extraction of construction timber, wood was also to be extracted for the production of charcoal, which was needed in the pig iron works. However, this was not realised. The failure of logging and the inadequate use of the reservoir's timber caused heavy losses of several hundred million US Dollar.

One of the important problems in tropical reservoirs is the mass development of aquatic macrophytes. This causes several problems, e.g., the reduction of the oxygen content of the water and the production of phytoplankton responsible for increased loads of organic material and interference with navigation and fishery. Furthermore,

133 Fearnside has the merit of having pointed out this problem at an early stage and for having explained this in detail in numerous publications, e.g., 1989a; 1997b; 2001a; 2002; 2005, among others.

problems occur with proper flow through turbines and improved living conditions for the vectors of tropical diseases, particularly malaria, schistosomiasis and filariasis.

While in Curuá-Una, the relatively small reservoir of the first hydroelectric plant near Santarém, the macrophyte *Eichhornia crassipes* seriously infected the waters, in Tucuruí because of the low content of nutrients the areas infested have been much smaller than was previously feared (Junk and Mello 1987). Macrophyte areas concentrated on the western bank of the Tucuruí reservoir in an area of approximately 300 km².

A favourable situation existed in Tucuruí with the short retention period of water in the reservoir. The water exchange varied from 100 to 120 days between June and October and only 35 to 40 days in the highwater period from November to May. During the peak flow this water retention was only two to three weeks. A quick succession of water renewals leads to better water quality, rapid recovery of oxygen levels and better living conditions for the fish population.

Due to the low content of sedimentary material in clear water rivers, the problem of large sediment deposits did not exist in the Tucuruí reservoir. As deforestation increased, the risk of erosion made protective measures necessary, especially in the peripheral areas of the reservoirs.

Schistosomiasis and Chagas disease occur in the northeast of Brazil, from where there was a massive migration to all projects in Eastern Amazonia. In Tucuruí, a large proportion of the construction workers came from the Northeast, increasing the possibility of the spread of these diseases. The intermediate host of the schistosomiasis disease, the *biomphalaria* water snails, are found in Tucuruí. In the large shore-line areas only periodically flooded, suitable breeding conditions for Anopheles prevail, a high index of malaria infections has been already wide-spread in this region. In Tucuruí, a dramatic impact was caused by mosquitos of the genus *mansonia*. These mosquitoes do not transmit malaria but can transmit several arboviruses. After filling the Tucuruí reservoir, *mansonia* populations, biting night and day, increased tremendously because of breeding grounds in aquatic weeds in the reservoir. This caused a considerable migration of residents to other locations. Especially the settlement area of the Parakanã was affected (Fearnside 1999).

Fishery was a very important subsistence economy in the Tocantins region. The problem of dams is related with the prevention of fish migration to their breeding areas. Fish ladders were not installed at Tucuruí, certainly a negative impact of hindered migration. Parasite infections of fishes did not occur in the first years of the Tucuruí reservoir. Fishermen informed that there were good living conditions for Tucunaré, a commercial fish, in the reservoir. Voracious piscivores live mostly in quiet waters.

The Curupira operation has been widely announced as the largest animal salvage activity ever recorded in the areas to be flooded. Actions of animal salvage were undertaken in cooperation with specialised Brazilian institutes. Although these activities can be interpreted as a signal of environmental awareness – with a lot of public relations propaganda from Eletronorte – it must be stressed that positive effects are doubtful, as the animals invade other habitats and cause environmental pressure.

One of the problems stirring up public discussion was the use of toxic herbicides for clearing rain forest areas for Tucuruí's transmission lines. The use of the herbicide Tordon 101-BR by a contractor in 1981/82 for clearing 300 m wide corridors for the

transmission line Tucuruí–Mojú–Belém was proved by a commission of the state of Pará. Cases of animal intoxication and poisoning were related to the use of that herbicide. The Minister of Agriculture of Pará condemned the defoliation activities and initiated legal proceedings against the company. Eletronorte, responsible for the order to clear the corridors, stated in a documentation that there was no scientific proof. As Tordon, which is no longer produced today in Brazil and has a very high dioxin content, was extremely dangerous, its use was banned for defoliation work on large areas. Public discussion had a positive influence.

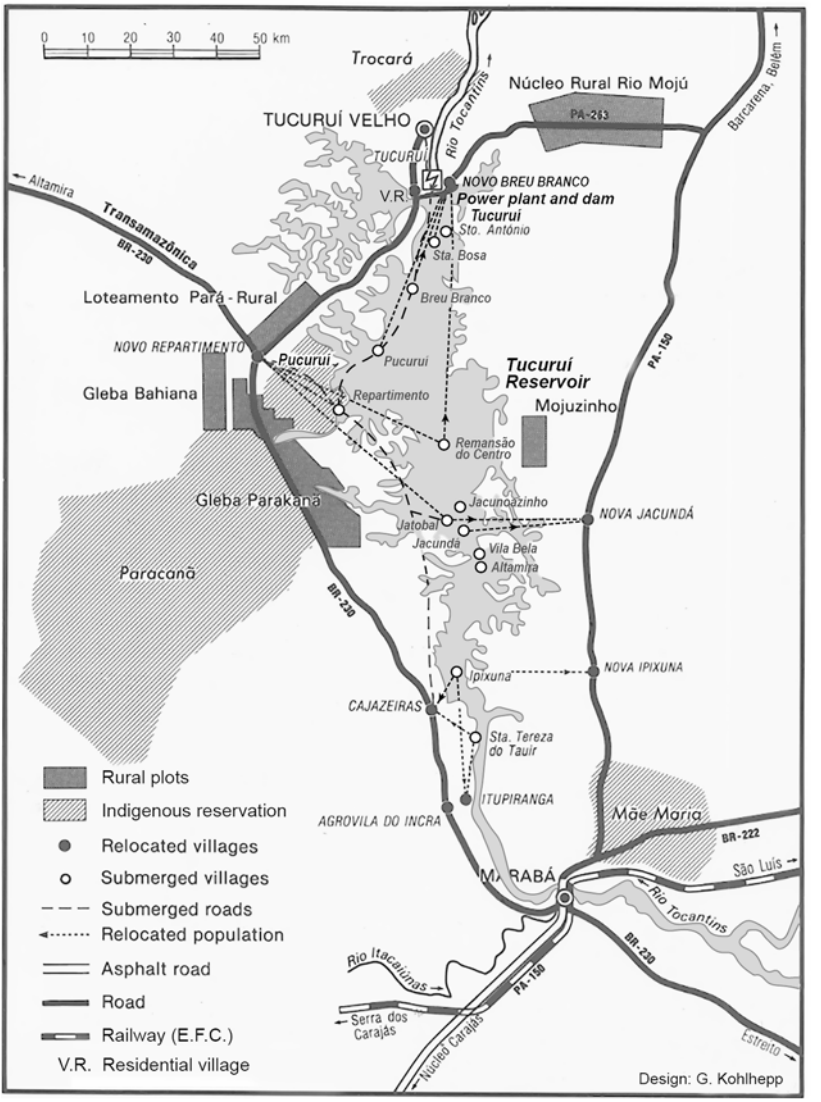
4.3.3. Resettlement problems and socio-economic impacts of the Tucuruí project

As is well known, the evacuation and resettlement of socially very differentiated large population groups within a short period of time results in fundamental problems. In Tucuruí, Eletronorte put the affected population at 16 637 in November 1982. Two years later this number was fixed at 17 319 due to an accelerating migration process. Eletronorte interpreted this process as a result of "planned invasions" in order to participate in the indemnification process. "Hired occupants" cooperating with land speculators were said to have infiltrated the area, sometimes stirred up by local politicians. Even if this was the case, it was obvious that the resettlement concept in Tucuruí was not much better compared to previous negative experiences in Brazil, such as Sobradinho on the Rio São Francisco or Itaipu on the Rio Paraná (Kohlhepp 1987c).

No planning authority with sufficient executive and financial resources was created, and there was no strategy for comprehensive resettlement and no precise coordination of the corresponding measures (Mougeot 1986). Within four years (1980–1984) about 4000 procedures were carried out. Soon there were complaints against the implementation of compensation, as the procedures did not reflect the reality of regional land ownership and agricultural structures. All the problems known from other projects occurred repeatedly: A large part of the population had squatter status; compensation formalities were based on proof of land titles, and cash compensation for investments by non-landowners was low. The provision of alternative land was slow and uncoordinated, cash payments were devalued by inflation, owners of large farms were supposedly compensated more cheaply, and the resettlement of people was slowed down.

In 1983, a protest movement began, supported by CPT and other NGOs. People refused to move to Nova Jacundá, one of the new urban settlements planned. In fact, the structure and implementation of urban centres for resettled people were significantly changed by the administration and financial constraints of the programme. In 1984, protest actions became more intensive. More than 1000 people camped in Novo Repartimento for weeks, in order to get crop losses indemnified, having been caused by the damming-up of the Tocantins at an earlier date than previously fixed. The protests focused on the period between the expropriation and the provision of new land, as the settlers had stopped their agricultural activities in anticipation of the resettlement, which sometimes took place five years later. Refusal of indemnifications by Eletronorte provoked actions of civil disobedience and was accompanied by blockade actions and military police counteractions.

Fig.16: Tucuruí hydroelectric power plant and reservoir. Relocation of the population



Source: Cf. Kohlhepp (1987b, 237); based on Eletronorte documents.

Fig. 16 gives a detailed survey of the submerged and relocated villages and the directions of the relocation process. Furthermore, the new rural allotments are indicated. There have been many constraints as to a successful rural resettlement: A bad infrastructure for access to land, lack of financial and agrotechnical support as well as of social assistance.

The situation was completely confused in the recently established INCRA agricultural colonisation projects along the Transamazônica near Marabá. Settlement had progressed until 1979, when public authorities already knew that this area would be

partially flooded. The Transamazônica had to be partly rerouted north of the Agrovila do INCRA, all investments of the settlers were lost, and institutional and technical investments had no return. Not to mention the human problems of the people who had to be evacuated just a few years after settling in a state-controlled rural project. The compensation for these people did not even cover the transport costs for agricultural equipment to the new destination. The resettlement procedures also affected the Parakanã Indigenous groups.[134] The Indigenous areas of the Parakanã and Pucuruí had to be redefined. Although the total area has been even enlarged, the Indigenous population lost their traditional access to the Tocantins fishing grounds.

When Eletronorte refused to negotiate with groups but insisted on discussing problems only individually, a collective consciousness process began that articulated the fundamental problems. As information about the compensation procedures was very scarce and the complex bureaucracy had created uncertainty, the CPT supported the resettlement of the *posseiros*. Joint solidarity actions and protest movements were organised, and the settlers received advice on how to proceed in negotiations with the company.

According to statistical data of Eletronorte (1986) nearly 4950 indemnification processes had been formalised. 135 000 ha had been acquired for resettlement purposes. 2205 plots were distributed in urban areas (Nova Jacundá 793, Novo Repartimento 669, Novo Breu Branco 568, Itupiranga 75, Cajazeiras 100), 2876 in rural areas. 1222 houses were built, particularly in urban settlements and in the Núcleo Rural Rio Mojú.

The total number of compensation procedures and the number of resettlements suggest that the number of people affected by the damming of the river and the construction of the Tucuruí reservoir was 25 000 to 30 000. As outmigration took place which had occurred during the first years, the number of relocated people could amount to 35 000. Some people had to wait for more than 30 years to receive indemnification (Xingu Vivo 2012).

Eletronorte officials complained of a high percentage of families who sold the urban or rural plots immediately after having been indemnified. It is obvious that large-scale projects were always accompanied by land speculation. In Tucuruí, speculation has been duly organised by some groups. This problem has been known for a long time and was related to the uprooting of people through resettlement. As the original riparian communities could not be transferred in their full social context and there were often no economic opportunities in the new settlements, migration was the result. The new urban centres were provided with water, sewage and electricity facilities, but the situation was characterised by the "usual" disagreement between the big company that builds the settlement and organises the resettlement and the state or municipal bodies that have to bear the related costs.

A visit in October 1986 in one of the "urban" nuclei, Novo Breu Branco, manifested a desolate state of this settlement. Streets were in bad conditions, mounts of garbage piled up without organised deposit, houses already demolished, and the area reserved for expansion was occupied by invasions. This suggests that planners overestimate the self-organisation capacity and private initiative of people who have no experience in this field. The new "ambiente" had been artificially created and the resettled population found no inner bond with it.

134 See chapter I, 4.5.2.

Many problems related to resettlement programmes could be avoided if the organisation started early and made sure to offer people economic alternatives. Indemnification procedures should be duly published and must be transparent to all people affected. Lacking sensibility of large enterprises to the daily problems and to the future existence of the population has been obvious. People have been uprooted and suffer from many physical and psychological problems caused by the shock of modern interference in their lives.

The downstream population on the lower Tocantins river suffered from the radical alteration of the aquatic environment. Fish catch declined by 60 %, which severely restricted the fishermen's ability to survive. The impact of Tucuruí on the Indigenous population[135] was irresponsible. The Tucuruí reservoir flooded parts of three reservations, the Parakanã lost 36 % of their territory. The transmission lines of the Tucuruí power station cut through four Indigenous reservations. The Parakanã tribe was removed five times by FUNAI in the 1970s and finally, in 1982, the remainder of this tribe was transferred by helicopter to a new village (Marudjevara) constructed by Eletronorte. Malaria and other diseases contributed to a high mortality. After a first assistance programme was discontinued in 1979, it was not until years later that a new aid programme was launched, which included health care, primary education, and assistance in securing the reservation's borders. A small amount of compensation was paid to the Gavião tribe for laying the transmission lines through the reservation. However, cash payments of compensation to Indigenous tribes remain problematic because they are not familiar with money and therefore, as in other cases, it is often not put to good use (Fearnside 1999). The allocation of land would have promised more success.

During the peak of civil works in 1982, more than 30 000 workers were contracted, living in four large residential camps near the powerplant site. The number of people employed decreased to 7400 in July 1986. The population directly associated with the Tucuruí project at that time was 22 500.

The Eletronorte company town (*vila residencial*) was very well equipped, and the houses were of good quality. In addition to the efficient "normal" functional inequality, there was a large hospital – probably the best in Pará outside Belém at the time – with excellent facilities, good school equipment, and a large leisure offer with cinemas, sports clubs, and playgrounds. As in many other cases in Brazil, the problem of maintaining a high quality standard after the completion of project implementation was one of the issues discussed by the residents.

Close to the company, the location of the old riparian village of Tucuruí Velho has proven to be extremely problematic. Migrants flooded the village and the population increased dramatically from 4000 (1975) to over 110 000 in 1986. After construction stopped, many of the dismissed workers remained in Tucuruí Velho without the possibility of finding a new job. All the problems that will be described in detail later,[136] occurred: no infrastructural capacity to withstand the existing population pressure, excessive unemployment, deformation of social structures, insecurity, and a high crime rate.

The Tucuruí power plant, which operated with seven main units in April 1986, distributed the electrical energy according to the following scheme: 50 % for the alu-

135 Cf. chapter I.4.5.2.

136 Cf. chapter I.4.5. Cf. Castro and Hébette (1989).

minium industry, 20% for the state of Pará (17% Belém), 12% for Maranhão (São Luís 6%), 10% for CHESF (Northeast), 4% for Goiás and the rest for the construction work in Tucuruí and the operation of CVRD. This shows that the aluminium industry was the dominant consumer.

4.4. Alumina and aluminium industries in the PGC region

4.4.1. General situation and energy prices

Brazilian bauxite deposits in the Amazon were the third largest known deposits in the 1980s. Since the first large bauxite deposits in Amazonia had been discovered in 1966 in the Rio Trombetas area outside the PGC region, these deposits became important for mining in the late 1970s. Within the PGC region, there are significant bauxite reserves in the Paragominas area south of Belém, about 50% of the known Brazilian deposits. However, the Trombetas deposits were favoured at the beginning of industrial activities.

The international interest in expanding aluminium production in Brazil had political reasons. Due to the – at the time – unstable situation in Jamaica, Guyana and Surinam, the large bauxite producers and the dominant multinationals controlling global aluminium production were looking for new location options. In view of the large raw material deposits in the Amazon region and Brazilian plans for the eastern Amazon, including large hydroelectric power plants, the PGC region became increasingly interesting. The PGC aluminium industry projects began construction when an alarming decline in global aluminium production reflected the extremely difficult situation of economic recession, bauxite surplus and subsequent price collapse. Even in this highly problematic situation, Amazonia was integrated into the volatile world market under the pressure of multinational interests and geopolitical misplanning by the Brazilian government, without taking into account financial, economic and environmental uncertainties.

The shift of aluminium production to developing countries can be seen in the Japanese companies, which reached a production peak of 1.2 mt in 1977, which abruptly declined in 1981 and amounted to only 0.23 mt in 1985. In 1983, Brazil already surpassed Japan in aluminium production, even before the PGC aluminium plants came on stream. In 1986, Brazil reached fifth place in the world ranking of aluminium production with 0.757 mt. The USA reduced its production by 25% between 1980 and 1985. The decline in aluminium production in the leading industrialised countries was also caused by strict new environmental legislation, which required heavy investment in pollution control equipment.

The most important location factor in aluminium production is a high availability of electrical energy at low prices. On average, electrical energy covers one third of the aluminium production costs. According to Albras/Alunorte industries, 15 400 kwh were needed to produce one ton of aluminium in September 1986, and 1250 kwh for one ton of alumina. High energy prices and, on the other hand, environmental concerns about aluminium plants in industrialised countries – especially in Japan – led to a relocation to developing countries.

With the construction of Tucuruí, Brazil enabled a direct and permanent supply of large amounts of energy to nearby consumers. All over the world, large consumers in the industrial sector received significant price discounts. However, in the case of Tucuruí energy for Alumar and Albras/Alunorte aluminium production prices were exceptionally low. Tucuruí energy prices were US$ 0.032/kwh in September 1986.

In 1986, Albras alone consumed 63 % of Tucuruí's energy production. According to a decree issued by the Ministry of Mines and Energy in August 1979, energy prices for the aluminium plants were to be reduced by 15 %. However, in 1986 the industries paid far less. The figures varied between US$ 0.016 and US$ 0.0075/kwh, i.e., the aluminium industry received a reduction of at least 47 %, but more likely 77 % (Kohlhepp 1987b). If the financing costs of all loans for Tucuruí are taken into account, the rates for electrical energy amounted to only 23 % of the effective energy production costs (Altvater1987b).

Thus, enormous public subsidies of well over a hundred million US Dollar per year were granted to satisfy the aluminium producers. Despite these high subsidies, the production costs for aluminium were higher than the world market prices. This explained the high pressure that the aluminium producers put on the electricity company Eletronorte. The prices for electrical energy had been agreed for a period of 20 years. All attempts to negotiate prices failed because of the aluminium sales crisis, which forced a reduction in production costs to a level that could not be compensated.

When planning the aluminium industries, energy costs had been set at a maximum of 20 % of the world market price for aluminium. Based on the reduced Tucuruí rates, the share of energy costs in the PGC aluminium projects was only between 9.4 and 18.8 %. The subsidisation of energy prices allowed rates of only 37.6 to 75 % of the average energy prices in global aluminium production. In the United States, energy prices in aluminium production were 4.5 times and in Japan even more than 6 times higher than the average Tucuruí price (Kohlhepp 1987b).[137]

4.4.2. Locations of alumina and aluminium plants and status of projects in the second half of the 1980s

4.4.2.1. Albras/Alunorte at Barcarena, Pará

Alumina or aluminium oxide is the biggest cost factor in aluminium production. High quality alumina is required to produce high quality aluminium metal with low environmental impact. The location of the large industrial complex for alumina and aluminium production was determined 40 km south of Belém in the municipality of Barcarena at the port of Vila do Conde (Fig. 11). The decisive factors were the relatively close power generation of Tucuruí (330 km away), which is connected with 500 kV, and the bauxite deposits of the Rio Trombetas, a northern tributary of the Amazon, 1100 km upstream.

CVRD has been active in the bauxite and aluminium sector since 1974. Since the Canadian company Alcan, which had discovered the excellent bauxite in the Trombetas region, was not interested in setting up a bauxite project, CVRD decided to become the main shareholder in the mining company Mineração Rio de Norte (MRN) (46 %;

137 All data based on informations by Eletronorte (Brasília, 24.09.1986), Albras/Alunorte (Barcarena, 25./26.09.1986).

Alcan 19 %; Cia. Bras. de Alumínio 10 %; Billiton-Shell 10 %; Norsk Hydro 10 %; Reynolds 5 %; Alcan Aluminium Ltd. 5 %). A mining project with a capacity of 3.3 mtpy had been planned and the project became profitable when aluminium prices started to rise in the mid-1970s.

Since bauxite export to Japan was not possible at the time for cost reasons – only ships with up to 35 000 tdw could navigate the Trombetas river – a Brazilian-Japanese joint venture in the alumina sector with a plant location in the Amazon region was envisaged. In 1976, the first bilateral contracts were signed and in 1977 the Nippon Amazon Aluminium Co. (Nalco, later Naac) was founded in Japan. CVRD founded Valenorte Alumínio Ltda. as a subsidiary.

Two plants had been planned:

Alumina production: Alunorte (Alumina do Norte do Brasil Ltda.) (Shareholders: CVRD 61 %; Naac 39 %)
Aluminium production: Albras (Alumínio Brasileiro S.A.) (Shareholders: CVRD 51 %; Naac 49 %)

The Japanese involvement in Albras and Alunorte was based on efficient infrastructure, fully financed by Brazil, in particular electric power from Tucuruí, ports and access canals, urban development, roads, etc. Tax incentives were also granted. As the Japanese aluminium production had growth rates of 20 % until 1977 (maximum 1977: 1193 mt), Albras' initial production plan called for 0.64 mtpy of aluminium and 1.3 mtpy of alumina.

In 1981, the financing contract was signed when international prices had passed their peak and the aluminium crisis became obvious. The Japanese contract partners insisted on a production of only 50 % of the earlier plans. Alunorte and Albrás production was scheduled to start in June 1984. The complex was and is one of the largest in the world and the largest in this sector in Latin America. The investment costs for Albrás were US$ 1.3 billion and for Alunorte US$ 0.62 billion. 70 % of the total investment was loans, 30 % was cash from the shareholders. An area of 26 000 ha was acquired in Barcarena for the siting of the facilities. The natural conditions of the port site in Vila do Conde on the banks of the Rio Pará were favourable and allowed access to vessels of 35 000 tdw, as well as in the Rio Trombetas.

Albras commissioned the first production stage (160 000 tpy) in 1985. Alunorte slowed down the implementation of the project due to unfavourable conditions in the world alumina market. CVRD's own bauxite deposit at Rio Trombetas was not used for Albras' aluminium production, as Alunorte's construction did not proceed in the face of low world alumina market prices that could not compensate for its own alumina production. This was the reason officially given by Albras in October 1986, but certainly not the only one, as its competitor Alumar (Alcoa/Shell/Billiton) in São Luís was supplied by MRN (main shareholder CVRD) with bauxite for its integrated alumina industrial complex in São Luís. In contrast, Albras – as Alunorte was not yet completed – imported alumina at compensation prices from Surinam, Venezuela and Jamaica.

In December 1986, Naac announced its withdrawal from the Alunorte project. The Japanese counterparty refrained from further participation in view of the price development and a disagreement with CVRD about the further implementation and financing of the project. The plants, which were only about 50 % completed, were tem-

porarily shut down.[138] In 1987, the president of Albras described the Alunorte project as "paralysed but not dead" (CVRD 1987, *Jornal da Vale* 13: 107).

In the meantime, MRN had increased bauxite production and sales to 4.4 mt, 75 % of which was for export and 25 % for the domestic market, i.e., to supply Alumar in Maranhão. The excellent raw material and the modern port facilities on the Rio Trombetas were therefore not used for CVRD operation in Barcarena.

Albras reached a production of 160 000 t in 1987, which was exported to Japan as well as to Europe and the USA. In the same year, CVRD announced the start of preparations for stage 2 in October 1987, which envisaged a production of 0.32 mtpy of aluminium in 1991. The CVRD-Naac joint venture in Albras remained unaffected by the Alunorte situation. The total investment for Albras had been calculated at US$ 1.369 billion.

There was a long and complicated discussion between the partners on the implementation of stage 2, with the problems being the low aluminium prices on the world market and the appreciation of the yen, which made it necessary for Brazil to negotiate on a US Dollar basis. As Brazil's debt to the Japanese had increased from US$ 3 60million to over US$ 600 million due to the appreciation of the Japanese currency on the international market, a refinancing of US$ 560 million was negotiated with a grace period extended to 8 years and repayment extended to 20 years.

Due to project delays and financial constraints in federal government programmes, the construction and implementation of Barcarena townsite, the project's planned urban centre (*Vila dos Cabanos*), also remained in a precarious state.[139]

4.4.2.2. Alumar at São Luís

The Alumar industrial complex, an alumina refinery and aluminium plant in the southwest of the capital of the state of Maranhão São Luís, was the largest private investment ever registered in Brazil. The total planned investment was US$ 1.5 billion. Alumar's shareholders were Alcoa do Brasil (60 %) and Billiton (40 %). Alcoa do Brasil was a subsidiary of Alcoa, the world's leading aluminium company, which had started operations in Brazil in 1965. Billiton was part of the Royal Dutch Shell group, which was involved in bauxite mining in Trombetas.

Plans to install huge alumina and aluminium industries had already led to protests in advance. There were fears from scientists that environmental impacts such as water pollution, air pollution and damage to ecological conditions would negatively affect the Baixada Maranhense (Ab'Sáber 1996b). This was especially true since the expansion of the metropolitan region of São Luís had already led to major environmental damage, which would be exacerbated by the coming heavy immigration.

The start-up phase of the integrated production of alumina and aluminium began in August 1984 with 500 000 tpy of alumina and 100 000 tpy of aluminium. The second phase was opened at the end of 1986, when aluminium production reached 245 000 tpy. In 1984, the Brazilian consortium Camargo Corrêa, originally a construction company with commitments to major projects throughout Brazil and now systematically diversifying its activities, acquired 35 % of the shares of Alcoa do Brasil.

138 During the visit of the author in August 1987 (cf. Kohlhepp 1987b).

139 See chapter 4.4.4.

Alumar's site was located in the port area and allowed for the unloading of bauxite from Trombetas. The port was used exclusively by Alumar and was equipped to unload vessels up to 40 000 tdw. An area of 1700 ha was set aside for the construction of the plant in the industrial area of São Luís, 25 km from the city centre. Another large area was reserved for the deposit of red mud and for an environmental buffer zone. In mid-1986, Tucuruí supplied the Alumar company with one third of its production of 5 turbines. The power grid of Tucuruí transported electrical energy via Marabá–Imperatriz to São Luís with a transmission line of 500 kV over a distance of 1030 km.

Unlike Albras, Alumar was supplied by MRN with bauxite from Trombetas. As MRN's prices were five to six times higher than Australian bauxite (excluding transport costs), Alcoa planned to open mining in its own deposits in the Trombetas region. The very modern facilities of Alumar, the leader in Brazilian aluminium production, allowed for integrated industrial processing of bauxite–alumina–aluminium. In the late 1980s, there were even discussions about expanding Alumar's production from 0.5 mtpy of alumina to 3 mtpy and from 245 000 to 380 000 tpy of aluminium. Alumar's calculations depended on the multinational strategies of Alcoa and Billiton, and it was difficult to compare their raw material policies with those of Albras/Alunorte.

4.4.3. Environmental problems at the alumina–aluminium projects of the PGC-region

During the construction of the Alumar industrial complex, environmental movements protested against the huge, land-intensive plants for the production of alumina and aluminium, which had been built without prior public discussion or detailed information. Apart from the impacts of the construction with deforestation, destruction of mangrove areas and resettlement of settlers, the problems of retention and dumping of the highly toxic red mud produced in the refining process of alumina production were particularly alarming. The ratio is: 1000 kg of alumina = 830 kg of red mud. These residues, which contain very toxic and corrosive substances, are the reason for the pollution of the groundwater (Kohlhepp 1987b; Kohlhepp *et al*. 1987).

The initial confusion was compounded when the Secretary of Natural Resources, Technology and Environment, responsible for the control of industrial activities in Maranhão, declared that his agency was unable to carry out this task because of a lack of qualified technicians. The public distrusted not only the monitoring capabilities, but also the pressure capacity of the national authorities towards the multinationals. NGOs and government representatives were convinced that public protests contributed significantly to environmental protection measures.

Alumar had 1800 ha of land for its huge facilities and conveyor belts. 2000 ha were officially ceded to Alumar and used for the ponds to deposit red mud. Each pond had an area of 15 ha and was sealed at the bottom with a 40 cm layer of compacted clay, covered with a protective PVC sheet to prevent groundwater intrusion. The solids settled while the liquids were returned to the refinery's tanks by pumps. This water recycling process allowed the company to significantly reduce water consumption, which had originally been a critical point in the evaluation of the plant site and in the public discussion.

The area of 2000 ha has to be transformed after the soil is reprocessed and new green areas must be created. The PVC layer under the red mud remained unless this

material could be reused in the ceramic or cement industry. At that time, in Japan red mud was still deposited in the sea.

To retain the residues, a drainage system and a rainwater control system were installed. The wastewater was treated in a sewage plant, the only one in Maranhão. Air pollution was greatly reduced by meeting the filtering conditions of highly industrialised countries. A green buffer zone of 5000 ha was acquired and ceded to the government on the condition that Alumar take responsibility for this area. Obviously, this area served more for the plant's own safety and to avoid compensation payments to adjacent residential areas in case of emissions than for the protection of natural vegetation. Cooperation with universities and specialised institutes was carried out with monitoring programmes regarding soil, vegetation, water quality and special projects (e.g., marine biology).

In the 1980s, alumina and aluminium production in industrialised countries faced extensive environmental regulations and protests against the traditional locations of these industries. In Japan in particular, relocating these plants to developing countries was therefore one of the solutions. Among many foreign investors in this industrial sector, the idea of installing industries with lower environmental standards prevailed. The Amazon and the PGC development programme with subsidies and tax benefits from the Brazilian government was one of the most attractive options. While the Military Government was initially very keen on high investment and approved a weak control system for environmental damage, re-democratisation in the second half of the 1980s allowed for public discussion and protest movements and helped to introduce ecologically appropriate production conditions. The activities of some well-organised NGOs contributed to the improvement of environmental protection measures in industrial production.

The Albras/Alunorte plants in Barcarena were only partially operational in the mid-1980s. As the construction of the alumina power plant was considerably delayed and partly cancelled, there were no problems with red mud at that time. Ecological studies were only carried out after construction had already begun. According to the company, Albras' environmental protection measures met Japanese standards.

Due to the difficult economic situation of the aluminium industry, the administrative problems with Japanese colleagues and the political conflict of competence between federal and regional state authorities, it remained questionable whether the environmental protection measures would be maintained at all levels. This was already the case with the construction of the new townsite of Barcarena and its environmental impact.

4.4.4. Socio-economic impacts of large projects

The spatial impact of large-scale projects directly affects the local or regional population. In fact, large areas of land were expropriated and most settlers – as is common in Brazil – did not have land titles for the rural or urban properties they used or occupied. Since information about the planned projects was always sparse and usually arrived late, rumours increased the uncertainty of the affected population. Without consideration of the vital needs of the population, usually without economic alternatives, the resettlement programmes were often – sometimes intentionally – not planned in advance but were carried out unexpectedly and had catastrophic effects on the popula-

tion. The affected people were often blamed for standing in the way of planners. They were terrified of the coming problems, in many cases unable to articulate themselves, unresponsive to the logic of the planners, trying to escape their despair on an emotional level and completely confused by the discussions that were incomprehensible to them. The breakdown of social interactions of those to be resettled can never be compensated.

The implementation of large-scale projects was not coordinated in any way with regional or local administrations and – even worse – no financial provision was made for the socio-economic and spatial design of the emerging scenarios. This was not the fault of the municipal urban planning departments – if they existed at all at that time – but the problem of higher-level decisions and the lack of responsibility to pragmatically analyse and remedy the consequences. Given the poor situation of most of those directly affected, it was not surprising that they sometimes believed dubious consultants or lawyers, which complicated their situation.

The initial high attraction of large-scale projects can be explained in most cases by the employment capacity of construction companies. The possibility to get a job even without special professional qualifications, to eat and live in the contractors' camps led to a high rate of migration to the project areas. The socio-economic structures of the project suddenly changed. New patterns of organisation were "imported". Prices for goods and services rose rapidly. New neighbourhoods emerged with expanding prostitution around the construction workers' camps. Immediately after the completion of parts of the project or the end of project work, most of the temporary migrants working at the site faced economic collapse as their employment contracts ended. Often, workers were treated very badly by the subcontractors and there were even fraudulent contracts.

Very often there was no alternative employment or continuation of contracts in other projects. On the other hand, many of the workers were socially uprooted, so there was no return to the region of origin. Without wages, food and housing, they contributed to the mass of people without a livelihood, which led to the extremely high growth rates in the urban centres. Large favelas emerged, invasions of urban properties were commonplace, and crime rates increased significantly. Left alone to deal with these problems, the local administration was overwhelmed and helpless in view of the scarce budgetary resources and the extent of the extremely serious problems. The infrastructural capacities were exhausted at all levels and in all areas.

Large-scale projects often lead to enclaves with artificial structures that are spatially isolated. Access to the company towns is strongly controlled and socially segregated from the surrounding area. Polarisation effects prevail and intra-regional disparities steadily increase. Spreading effects, as expected in theoretical conceptions, rarely occurred and when they did, interactions were again segregated. Social contacts could not be realised in the informal sector either. The supply of food could not be provided regionally, and the supply of the company towns was organised from outside the region.

Since participation in economic progress has been reserved for a relatively small number of people with permanent jobs, – workers with higher qualifications are often not of regional origin – resentment and envy are widespread and social tensions and conflicts of interest with the excluded majority are rapidly increasing. Lack of perspectives further restrict the scope of life and action of those people who could actually be

called "victims of the planners." It is not only a financial problem to look for solutions, but a fundamental question of human dignity to deal decently with the problems of those affected. Special attention needs to be paid to the subcontractors' employment contracts and the treatment of the workers.

This socio-economic situation of large-scale projects of the 1980s has unfortunately not changed in recent years and can still be observed today in many of the state-organised or private projects in Amazonia and throughout Brazil. Appropriate parts of the project costs should be reserved for accompanying measures to minimise the social and ecological impacts.

Case study: São Luís/Maranhão in the 1980s

São Luís had an urban population of 124 000 in 1960, which increased through natural growth to 168 000 (1970) and 183 000 (1980). The district of Anil in the municipality of São Luís, on the other hand, increased its urban population from 38 000 (1970) to 222 000 (1980). This quarter of the São Luís urban area received most of the high immigration to São Luís in the second half of the 1970s, when the PGC projects were announced.

In 1987, the urban population of the São Luís conurbation was more than 650 000 people. The capital of the state of Maranhão, which became one of the cornerstones of the PGC, was literally overrun by a completely uncontrollable wave of migration from the neighbouring states of the Northeast and from the interior of Maranhão. The average growth rate of the São Luís population was 8 % per year between 1980 and 1985.[140]

In PGC project planning, the municipality of São Luís lost 190 km² for large project areas, especially for the CVRD and Alumar projects and an area reserved for a planned steel industry (Siderbras). The construction of Alumar resulted in the resettlement of more than 20 000 people. CVRD reported that 700 squatters were living on the company's land. They were compensated and resettled in a 44 ha area ("hill of hope"), which was acquired by the company and equipped with basic infrastructure measures: water and electricity supply, school, social centre, recreation area. A special housing programme was implemented by the CVRD for low-income workers.

There was no coordination with the town planning department during the construction work. The urban planners of São Luís shared that enormous migration at the beginning of the 1980s had disastrous effects on the urban infrastructure. In addition, federal interference occurred in the activities of the National Housing Bank (BNH). Large areas of land were acquired from private landowners, in some cases far outside the urban core area. The BNH started to build its standard houses in drab neighbourhoods without social infrastructure. The BNH settlements for more than 25 000 people did not meet the needs of the lowest social strata. But even for families earning a regular minimum wage, only transport costs from the SAB area to the city's tertiary sector or to school for three people per family amounted to the minimum wage.

All transport facilities for this population had to be organised by the municipality and had to be subsidised. The enormous social costs of the population increase could not be compensated by tax income of the municipal administration, as tax exemption and reductions were conceded to large projects and other taxes were not on the

140 Demographic data according to the municipal administration of São Luís. In 2022, the São Luís metropolitan area had a population of 1.63 million (IBGE 2023).

municipal level. Land speculation has been unimaginable. Prices for ground, houses and apartments have increased to such an extent that industries and even CVRD were building houses for their staff.

The permanent employment effect of the projects in São Luís after the end of construction works was no more than 2500 jobs. However, for the higher-ranking jobholders working conditions, professional training, and social facilities, even for their families, were very good.

About 30 % of the city area had been "invaded". The city administration had no financial means to implement an alternative housing concept for the *favela* population. Only less than 55 % of the city's population had a regular water supply, 39 % had sewage systems, and only 18 % were picked up by the rubbish collection. According to a São Luís city planning officer, urban planning was reduced to a mere and inefficient management of a mess caused by the inappropriate and uncoordinated approach to major projects.

Case study: Barcarena/Pará

A department of urban development (Codebar) had been established as part of a federal agency to build the urban area for the Albras/Alunorte industrial complex. In contrast to São Luís, all urban facilities had to be created in Barcarena, 40 km south of Belém. An area of 26 000 ha was acquired. The resettlement of the 482 squatter families living in this area was organised by setting up an "agricultural colony" on a very small area of only 1200 ha with plots of 2.5 ha per family. Because of the good market access in the new town or in nearby Belém, an intensive agricultural production model with horticulture was planned. Since the resettled population was not used to horticulture and the natural conditions in the area were also poor, this project failed. It was a typical example of the dreams of irresponsible planners who completely lacked local expertise. The shock of the construction of an industrial macro-project had driven away many settlers who had previously practised subsistence farming and fishing. Some migrated to Belém or the surrounding area when they were compensated and sold their rural properties.

In September 1986, despite the activities of a small working group of Albras in the social sector and some agricultural projects with the University of Pará (fishpond, etc.), the "colony" was in a desolate state (Kohlhepp *et al*. 1987; Castro and Carmo 2019): isolated, insufficient water supply, extremely poor central facilities, no school equipment, no medical care, no medicines. The children rarely attended classes as they had to walk long distances. This situation was caused by the political struggle between Albras (federal level) and the Pará state authorities. The large-scale Barcarena project was set up without prior consultation with the community and the state administration. However, the latter had to pay for the sudden costs incurred by the municipality. In view of an investment volume for the industrial complex of almost US$ 2 billion, it was hard to believe that there were no funds available to secure the existence of the resettled population.

More than 50 subcontracting companies occupied the area with 12 000 workers. Conditions were precarious and workers protested about food quality. The suppliers' camps extended to the small village of Vila do Conde. Traditional social relations and small-scale economic structures were completely deformed by the impact of the camps and the spread of prostitution. As in many other cases, the superficial economic boom

collapsed after the construction work was completed. The unskilled workers were laid off and the flow of money collapsed.

The main task for Codebar was the planning and implementation of a town with about 50 000 inhabitants. An excellent plan had been prepared in the early 1980s, but by 1986 this project was in a precarious situation. Delays and partial paralysis of the projects did not attract many migrants to Barcarena. At the time of the author's visit, only 800 families were living there. Due to the slow development of the "town," no shop owners were interested in setting up shops. The few shops had a range of low quality and high prices. Some of the establishments were already dilapidated. The residents of Barcarena were annoyed by the inadequate water supply and the lack of sewage facilities, as the sewage flowed directly into the Rio Murucupí, which was planned as a recreational area. The population protested because of the poor infrastructure and an open rubbish dump that was constantly burning. Codebar claimed that the difficulties were caused by the poor execution of the work by the contractors. However, the reason was the aforementioned problem of disagreement between the federal and state/municipal levels on all details of project implementation.

Besides these problems, there were the "usual" conflicts between the people from outside, the "arrogant *mineiros*" – in the eyes of the people of Pará – with better education and their "expert" status, and the local population, mostly made up of unskilled people. The *mineiros*, engineers and technicians from Minas Gerais with an industrial background, were full of prejudice against the population of Pará. They considered them lazy and unreliable. Sometimes social conflicts broke out. 62 % of workers in a higher position came from Minas Gerais (32 %), Rio de Janeiro and São Paulo, only 14 % were born in Pará. At the middle level, 35 % are from the Southeast of Brazil, 46 % from Pará. At the lowest level of employment, 80 % are from the Amazon and only 7 % from the Southeast.

The technicians of the different companies and of Codebar often lived in Belém, or when the opportunity arose, they fled from Barcarena to Belém. Most of the employees in the company town lived in a ghetto situation with little leisure time. The transport links to Belém were poor. One bus company monopolised transport by bus and ferry. Since direct shipping to Belém and back cost up to 10 % of the minimum wage, people felt trapped. This situation led to enormous problems and tensions as well as high job mobility.

4.5. Problems of regional development and conflicts in the PGC region

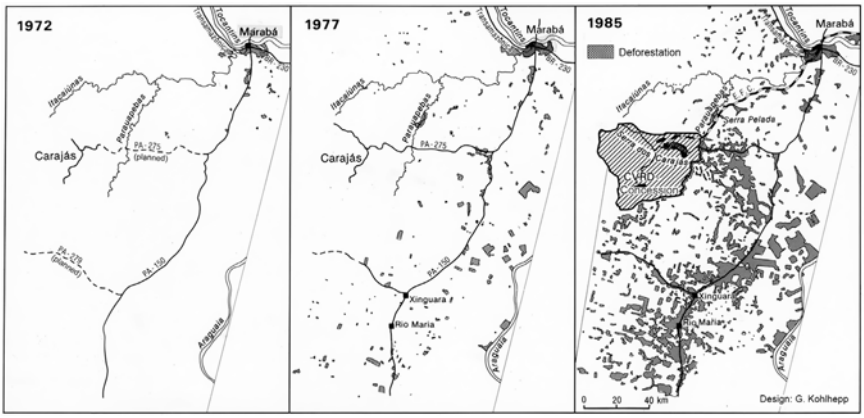
4.5.1. Deforestation in East Amazonia

Compared to the very rapidly increasing and alarming forest destruction during the agricultural colonisation process in Rondônia through cattle ranching projects and the mostly careless activities and impacts of road construction networks, even the large-scale projects such as Tucuruí and the Serra dos Carajás iron ore project had a relatively low rate of deforestation. However, since the construction of the Brasília–Belém road (BR-010), rain forest destruction has been a pervasive phenomenon in Pará, east of the Rio Tocantins, in the southeast of the state and in large-scale projects in Maranhão. Deforestation was no longer concentrated in corridor-like zones along the

main roads (Transamazônica, BR-230; BR-222, etc.) (cf. Fig. 11), but expanded to areas further inland, such as remote Gurupí and the central Rio Pindaré region.

One of the most affected PGC regions in the 1980s was the municipality of Marabá, the PA-150 state road south of Marabá and the PA-275 (cf. Figs. 12 and 13) to the border of the CVRD concession area. Charcoal production for the pig iron industry was the most important and devastating factor. Fig. 17 clearly shows the spatial impact of this clearing process, especially between 1977 and 1985. Since 1985, the forests along the road between Marabá and Parauapebas on the edge of the Serra dos Carajás, the main axis of migration, have been almost completely destroyed. In the 1980s, the pioneer fronts moved far beyond the Rio Tocantins to the west and approached the Rio Xingu. Economic interests and excessive land speculation increasingly focused on the region between these two river systems.

Fig. 17: Deforestation in the Carajás region: Marabá–Xinguara 1972–1985



Source: Cf. Kohlhepp (1987b); based on *Jornal do Brasil*, August 3, 1986.

The evaluation of Landsat satellite images for a region of 280 000 km² (= 31 % of the PGC region) in eastern Pará and western Maranhão made it possible to quantify deforestation. In 1979, almost 10 % of the forest area had been cleared. In the large municipalities of Paragominas and Imperatriz, this factor was 16 % and 32 % respectively. There were municipalities where more than 60 % of the area had been cleared, most of them in a short period of less than 10 years. By the mid-1980s, according to INPE, forest destruction in the PGC region, originally two-thirds covered by rain forest, had expanded to 28–30 %, with an annual growth rate of 3–4 %. In the state of Maranhão, with a natural rain forest cover of only 56 %, deforestation had already reached 62 % of the forest area by 1988.

As the IBDF regulations with the 50 % clause to protect the forest were generally not respected, there was neither a management structure nor the political intention to effectively control deforestation activities. Afforestation planning was not scientifically sound. The law that was supposed to encourage charcoal producers to reforest could not be implemented from the beginning. Official bodies did not provide any impetus through information campaigns or active support.

Not even the majority of the livestock projects officially approved by SUDAM complied with the Forest Code. Monitoring was extremely difficult due to the poor IBDF infrastructure. But even when violations of the Code were uncovered, fines were small and there was ample scope for evading official prosecution. The forest clearing activities of the large landowners had turned to modern technology. Power saws were widespread, and even the use of huge chains – 80 to 100 m long, weighing 10 t – pulled by tractors or caterpillars was common in regions where the trees had shallow roots, i.e., in forest areas with *cerradão* vegetation.

As for the extent of the acceleration of deforestation, some figures might illustrate recent trends in the 1980s:

It took the following number of man-days to clear one hectare of rainforest (Valverde 1987):

- using axis in the traditional method of wood-cutting without technological input and the availability of cheap manpower: 42 man/days
- using motor saw: 2 man/days
- using tractors and chains: 0.1 man/days

Specialised subcontractors (*empreiteiras*) carried out this "modern" version of deforestation and tried to fulfil their contracts as quickly as possible. They cared neither about the ecological nor the social impacts.

Thus, in addition to the already known ecological impacts of deforestation such as increased solar radiation, erosion problems, catastrophic changes in evapotranspiration and the entire water cycle, regional climatic impacts were observed for the first time: changes in the periodicity and length of the rainy season and dry sub-periods, reduction in rainfall. The use of heavy machinery had serious consequences, such as the compaction of soils or the complete tangling of the upper soil horizons due to the uprooting of trunks and roots.

In some cases, it was even possible to prove the use of "Agent Orange" for defoliation, which may have been smuggled in via the Manaus free trade zone. This was the case with a company in the municipality of Tailândia/Pará that laid high-voltage power lines from Tucuruí.[141] Fieldwork of the author in 1974 revealed two – isolated – cases of cattle farms near Paragominas that had conducted experiments with highly toxic chemicals to defoliate and increase the rate of burning.

Timber industry concentrated in Açailândia, Imperatriz, Marabá or Paragominas contributed to the extinction of many highly rated precious wood species, such as: mahogany (*Swietenia macrophylla*), rose wood (*Aniba roseodora*), maçaranduba (*Manilkara huberi*), ipê (*Tabebuia sp.*), jatobá (*Hymenaea martiana*), sucupira (*Diplotropia purpurea*), cedro-rosa (*Cedrela sp.*), angelim pedra (*Hymenolobium excelsum*), copaiba (*Copaifera multijuga*), piquiá (*Caryocar villosum*), tatajuba (*Bagassa guianensis*) etc. As the road network has been constantly expanded and improved, logging has increased excessively.

The already mentioned destruction of *Bertholletia excelsa* in the regions of Marabá, Ituporanga, Jacundá, Tucuruí and São João do Araguaia led to a 55 % decline in Brazil nut production (in Marabá from 1979–1985: 85 %). However, the most important reason was not the loss of Brazil nut area (1979–1983: 11 %), but a significant decline in the pro-

141 Cf. chapter I, 4.3.2.

ductivity of the *Bertholletia* stocks, the *castanhais*. During the period mentioned, productivity dropped by 49 %, probably due to the dry fog after burning, which paralyses insect pollination activity.

The acceleration of deforestation was often related to the indiscriminate use of fire. Due to very remote locations and lack of access, timber transport was sometimes impossible and even rare timber was destroyed. Land speculation purposes, which attempted to prove continuous land use, made burning an economic activity with a claim to land titles. The economy of the collectors was affected by the destruction of Brazil nut, *Hevea brasiliensis*, *Castilloa ulei* and other medicinal plants used mainly by the Indigenous population. Deforestation has destroyed their knowledge of natural resources and threatened the livelihood of Indigenous people in the PGC region.

The announcement of agrarian reform in the post-military period accelerated deforestation. Large areas of forest were cleared to demonstrate effectively organised land use – mostly defined as pasture – to secure land titles, improve credit opportunities and eventually prevent encroachment by land squatters, especially along roads. The flawed structures of the federal and state governments had permanently allowed overexploitation of forests, sometimes even involving public officials in dubious logging operations and questionable environmental impact assessments. By the late 1980s, the acceleration of tropical forest destruction in the PGC region was alarming.

4.5.2. Problems of the Indigenous population in the PGC region

As already mentioned,[142] the new agency FUNAI (National Indian Foundation) was unfortunately not able to fulfil the expectations for the protection of Indigenous groups. Subordinated to the Ministry of the Interior, FUNAI had to operate within the strict limits of the national guidelines for the development of the Amazon region. Under these conditions, its main task was to accelerate the so-called integration of Indigenous groups and to create a "free space" for the undisturbed implementation of projects in accordance with the decisions of the National Security Council of the Military Government.

In the 1970s, church organisations began a new phase of altruistic direct and indirect support for the Indigenous population. The CIMI (Conselho Indigenista Missionário) promoted the first Indigenous assemblies at regional and national level with groups that had been contacted decades before. This created an awareness of a common destiny among the tribes. The involvement of religious institutions was observed with restraint and sometimes rejection and obstruction by the Military Government. Especially in Eastern Amazonia, Indigenous groups began to free themselves from exploitation under the economic tutelage of FUNAI. The Gaviões, for example, began to directly market the products of their collective economy, especially the Brazil nut.

Starting from the discussion on human rights, in 1979 some Indigenous groups gained new allies in the urban sphere, especially intellectuals and certain professional organisations. The Brazilian Association of Anthropology, in commentaries, strongly criticised the government's planning in the Amazon and the abolition of FUNAI as the coordinating body for Indigenous affairs at the level of decision-making. In 1980, the Union of Indigenous Peoples was founded but not officially recognised. In 1982,

142 Cf. chapter I, 3.2.

when the Xavante *cacique* Mário Juruna was sensationally elected as a member of parliament, a permanent parliamentary commission on Indigenous problems was set up. This commission had to examine every law relating to Indigenous peoples that was presented to Congress. It was also decided to restructure FUNAI. Although 10 presidents replaced each other within only four years, this goal was by no means achieved. Despite the beginning of public discussion and the direct participation of Indigenous leaders in politics, some laws passed Congress that significantly restricted the Indigenous rights guaranteed in the Federal Constitution.

Once again, it became clear that economic interests far outweighed the fundamental interests of those Indigenous groups who, in the official language, "were not economically active but occupied large areas." This statement showed a complete lack of understanding and sympathy for an ethnic group threatened with extinction.

Despite the political commitment to demarcate all Indigenous territories, only 14 % of these territories were regulated at the beginning of 1982. In 1983 (Decree 88.118), the demarcation procedure was provocatively changed by setting up a working group with representatives of some ministries and other federal and regional authorities, defined as "expedient." In the same year, the government released access to mechanised mining by public or private companies in all Indigenous territories. Even the Geological Society of Brazil published a document in November 1984 that classified the known mineral deposits in Indigenous reservations as unnecessary. Furthermore, the attempt to legally prohibit the execution of all public works in Indigenous territories without the consent of the National Congress failed.

When the PGC intensified its activities in Eastern Amazonia in the early 1980s, the prevailing situation was characterised by increasing social tensions (Schmink 1982; Schmink and Wood 1984; 1992; Hall 1989) and an alarming number of encroachments on Indigenous territories in the area and – despite legal obligations – total insecurity towards Indigenous groups. There was no concrete concept for the future of the Indigenous population, which was severely affected by the large-scale projects planned and partly under construction in the eastern regions of Amazônia Legal. In the PGC region, an Indigenous population of more than 13 000 people lived in scattered so-called "Indigenous areas" or "Indigenous reservations," which were mostly endangered by road construction and invasions.

There were 32 of these areas in south-eastern Pará, in Maranhão and – exceptionally – in northern Goiás (today's state of Tocantins) (cf. Fig. 11). Several different Indigenous groups lived in the PGC region with completely different conditions of contact with the non-Indigenous population. While the Guajajara of Maranhão, the largest tribe with more than 6000 people, could look back on a long tradition of more than 300 years of contacts, there lived several Parakanã groups that were only identified and contacted in the early 1980s. The fact that more than 75 000 km² were classified as "Indigenous territories," i.e., 8 % of the PGC region, does not show the problems that the Indigenous population faced in the mid-1980s.

As mentioned above,[143] the CVRD, as the main actor in the PGC region, was involved in the decisions about the future of the Indigenous population, in particular in the World Bank loan and the agreement with FUNAI.

143 Cf. chapter I,4.3.2.1.

The Indigenous population of Maranhão (85 % of the total Indigenous population of the CVRD area of influence) belonged to the following language groups and tribes:

Tupi: Guajajara ,Guajá, Urubu-caapor, Tembé
They were living mostly in rainforest areas.

Gê: Gavião, Cricati, Timbira, Pucobié, Rancocamecra, Apeniecra, Canela
These tribes were living in forest regions and/or in *campo cerrado* areas.

The forest tribes of Pará (11% of CVRD+s area of influence) belonged to:

Tupi: Paracanã, Assurini, Suruí, Anambé
Gê: Kayapó, Xicrin, Cararaô, Gavião

In 1986, 12 territories had been demarcated in Maranhão, 6 in Pará and one in Goiás. The terminology and definition of the legal status of Indigenous territories may be resumed shortly:

"identified": technical reports had been approved by FUNAI; delimitation forthcoming
"delimited": proposed by FUNAI; homologated by a decree of the President of Brazil
"demarcated": land survey executed; demarcation work homologated
"homologated and registered at SPU": areas defined by a presidential act and duly registered as an inalienable estate of the Republic (SPU: Serviço do Patrimônio da União).

It is important to emphasise that even the majority of demarcated and homologated Indigenous territories were still not registered with the SPU.

Even the highest legal guarantee did not mean that the status and boundaries of Indigenous territories were respected by groups with conflicting economic interests. Since the boundaries were often drawn without anthropological knowledge, the borders were sometimes at odds with the basic needs of the Indigenous population. Therefore, occasionally even the Indigenous tribes ignored the "artificial" boundaries of their territories, which led to additional conflicts.

The ecological knowledge of Indigenous tribes was not respected and their land use, which contributes to the protection of biodiversity, was not appreciated (Posey 1982; 1985a, b). Posey's (1987) research on the Kayapó, among others, emphasised that irretrievable knowledge of ethnoecology, ethnopedology, ethnopharmacology and ethno-agronomy had been lost.

In the 1980s, there was a multitude of highly urgent problems related to Indigenous territories (Schmink 1982; Schmink and Wood 1984; Hall 1989), only a few of which can be addressed here:

Lack of demarcation: This was the case in the Cricatí area near Imperatriz in Maranhão. They assumed a fraudulent delimitation of their territory. The high voltage line of Eletronorte from Tucuruí crossed the area of the Cricatí. They were compensated for clearing a 100 m corridor, but according to the tribe's *cacique*, this was not done properly. The Cricatí (325 people) refused to double the Eletronorte line, which led to a dangerous situation.

The Guajá were hunter-gatherers and used a wide range of shifting. The 250 people lived outside the officially recognised territories, and some of them remained unknown until September 1985. Their territories in Maranhão, parts of the Gurupí Forest Reserve established in 1961, were divided by a large corridor planned for a future railway line from the Paragominas bauxite deposit to São Luís. Two "points of attraction" were established in the valley of the Rio Gurupí, but the Guajá refused contact and occasionally attacked prospecting teams and road workers. As the Gurupí forest reserve had been badly affected, the problem proved to be extremely complicated.

Invasion problems: In eight Indigenous territories in Eastern Pará and Maranhão, the worsening invasion problems should have been urgently addressed. Squatters, logging companies, Brazil nut collectors, cattle ranching projects, *garimpeiros* and mining companies were identified as the "usual" invaders.

The Kayapó reservation (population of 1400), located far to the southwest of the CVRD concession area, gained notoriety in a tragic way when the Indigenous population desperately resisted the activities of a *fazendeiro* who illegally invaded their territory and killed 21 workers.

The presence of *garimpeiros* in Indigenous territories either led to violent clashes such as attacks or the occupation of airstrips, or the contacts had dire consequences, as they spread disease, alcohol and prostitution.

One of the most complicated problems was the eviction of squatters from Indigenous areas. Since the solutions took a long time, the affected Indigenous tribes used the strategy of putting pressure on the institutions. Road connections were disrupted, bridges destroyed and even hostages taken. Due to the high population pressure on "unoccupied" land in Maranhão, the invasion problems could only be solved through land reform measures, which did not take place.

4.5.2.1. Consequences of PGC projects affecting the Indigenous population

The Carajás railway line caused an overlap in the Indigenous territories of Mãe-Maria, Caru and Pindaré (Fig. 11). The example of the Gavião (173 people) in Mãe-Maria (Figs. 16, 17), 40 km northeast of Marabá, was only the culmination of a long period of forced encroachment on Gavião territories. Traditionally, the Gavião exploited Brazil nuts. In competition with the non-Indigenous population in the region, the Gavião became cheap labour as Brazil nut collectors and eventually came under the control of FUNAI. In 1976, they decided to market their products directly. When the Eletronorte transmission lines cut 150 m wide corridors into their territory and some groups were additionally affected by the damming of the Rio Tocantins, the Gavião agreed to relocate the new village of Mãe-Maria in 1979. The basis of the settlement was the payment of compensation for the loss of their Brazil nut areas, large timber reserves, hunting grounds, fields and villages. It was one of the first examples of compensation agreements with planned cash payments in advance. However, the Gavião had to defend themselves with blockades and protests against a fraudulent calculation by the regional FUNAI authority and only received the money after four years, which in the meantime had been devalued by inflation (Vidal 1986).

That is why they were warned when the construction of the Carajás railway began in 1982, which was cut through their reserve over a length of 27 km and passed by their new village at a distance of only 3 km. Since sale of Brazil nuts had dropped to less than 5 % of the previous quantities and the daily passage of up to 15 iron ore and

passenger trains[144] significantly reduced their hunting opportunities, the compensation payments had to be used to strengthen educational institutions and support their agricultural activities. They insisted that compensation payments be advanced by the CVRD, which was responsible for railway construction. With the help of blockades of the construction work, they finally succeeded in obtaining fair compensation, which was, however, extremely difficult to determine. The CVRD contracts were regularly executed. This could be confirmed through site visits and discussions with lawyers from both sides.

The situation of the two other Indigenous territories Caru (312 members of the Guajajara and Guajá tribes) and Pindaré (337 Guajajara) along the railway line was already highly endangered before railway construction began. Large landowners, with the support of the Maranhão state government, "bought" land also within the Gurupí forest reserve. *Fazendeiros*, squatters and road construction companies had to reduce their areas considerably. Land conflicts and invasions led to an obvious degeneration of Indigenous communities, which was exacerbated by the influence of railway traffic.

As mentioned earlier, charcoal production for pig iron factories increased the pressure of deforestation by sawmills on Indigenous areas, causing fear and unrest. The attacks on the rain forest areas of the Indigenous reservations could hardly be controlled and threatened the fatal collapse of Indigenous communities. In 1986, the number of uprooted Indigenous people migrating to neighbouring towns increased, causing significant problems. In Marabá, the Casa do Indio was overcrowded, maintained to care for and protect migrant Indigenous people from negative influences in the urban area. Dozens of Suruí came here because living conditions in their area were deteriorating. In São Luís, the problems were even worse.

Case study: Cateté (Kayapó-Xicrim)

Initially, mining activities in the Serra dos Carajás had no impact on the Cateté reservation, which lies to the west of the CVRD concession area. The migration from Marabá to the southwest was blocked, the CVRD set up observation posts and maintained a protection zone between the Serra dos Carajás and Cateté. During the author's visit in September 1986, the danger was much greater due to numerous *garimpeiros* and squatters entering the area via the newly opened road to São Félix do Xingu (cf. Figs. 11, 12, 13 and 15).

The Xicrim of Cateté were still isolated and could only be reached by air, with access strictly controlled. The central village of Xicrim Cateté (312 inhabitants) was surrounded by intact tropical rain forest. The village still had the traditional layout. 16 large houses stood in a circle 80 m in diameter. While the shape of the houses was built in the old style, the building materials were partly modern, i.e., the palm leaf roof was reinforced with plastic.

The Xicrim population was obviously healthy, with many children running around. They were good-looking, funny, curious, active and attentive. This was a big difference from other areas where there was a general apathy. The health facilities were complete, rooms for counselling, treatment, including dental care, a well-stocked medicine store. A nurse was not yet available. Influenza and colds were treated frequently. Tropical

144 The situation has deteriorated extremely until today, with more than 60 trains/day in 2022. See chapter II.6.3.

diseases were very rare and even malaria could be reduced by disinfecting the houses. There were index cards of each resident with detailed information about diseases etc. In a few critical cases, the local patients and their accompanying family members were taken to the modern hospital of Serra dos Carajás.

The good health of the tribal population in Xicrim Cateté was reflected in the increase in population. Shortly after the first contact (164 people in 1962), the number dropped to 94 in 1967. Since then, there has been a steady increase, reaching 286 people in 1984. At the time of the visit, the population had 312 members. The Xicrim were still very well adapted to traditional ways of using natural resources. Hunting, fishing, gathering and shifting cultivation were practised to a sufficient extent. The result was a healthy diet.

The school was adequately equipped, but lessons in Portuguese were given by a teacher who did not know the Kayapó language. The cacique's son was well aware of the opportunity to criticise: he mentioned the leaking roof of the school building and demanded a new school made of bricks "like in the Serra dos Carajás." The Xicrim knew the borders of their reservation well and checked daily to see if there were any intruders. They wanted to earn money and asked for their motorboat to be repaired because they wanted to sell Brazil nuts directly in Marabá to avoid the intermediate trade and thus the interference of FUNAI.

This situation differed considerably from that of other Indigenous groups, e.g., the Urubu-caapor (494 people) in Alto Turiaçu, the Guajajara in Pindaré or the Assurini do Xingu (53 people) in Coatinemo, who had a high mortality rate and at times a zero-birth rate. Transmission of infections and tropical diseases were the most common reasons. Low birth rates were result of a no-future mentality, which was common in areas with many conflicts and invasions or in cases of multiple resettlements.

Case study: Parakanã (village of Marudjevara)

The village of Parakanã was located 180 km northeast of Serra Norte/ CVRD concession area (Figs. 11, 16, 17). In the 1970s, their territory was cut through by the construction of the Transamazônica. Their deplorable history continued. Although the Tucuruí plans were already fixed, their new territory was in the region that was flooded by the Tucuruí reservoir in 1984. After another resettlement, they were cut off from their traditional fishing grounds along the Rio Tocantins. They reacted desperately to this and violent confrontations ensued.

The inhabitants of the village of Marudjevara were contacted for the first time in 1977, some family groups only in 1983. Due to the exemplary organisation – there were index cards – it could be ascertained that the population increased from 61 (1983; Vidal 1986) to 82 in September 1986, 9 Indigenous people came to the village from another Parakanã group. The facilities of the Indigenous post were in good order. The men and older boys were absent during the visit because of a hunting trip. The women were very shy and did not speak Portuguese. The village was recently built, the shape and types of houses were different from the original ones.

The population lived mainly from hunting and shifting cultivation, which was organised with a long fallow period every three years. They were probably not used to clothes because of the recent contact and the women still seemed to have problems using them. There is a scientifically based discussion that it is nonsensical to give them non-native clothes. However, in other cases they asked for "modern" clothes. The

health and nutrition situation seemed to be good. Diseases were properly treated. The Parakanã carefully controlled the artificial boundaries of their territory, which fortunately was still large enough for their needs.

The Parakanã reservation was surrounded by large farms and *garimpos*. Deforestation was widespread and there was much slash-and-burn agriculture. The proximity to alluvial gold deposits made the protection of the Indigenous land extremely difficult. CVRD proposed a large buffer zone. Considering the intense activities of various social actors in the region, a conservation corridor should be established along the southern border of the reservation. Unfortunately, this could not be realised due to the small number of FUNAI and IBDF staff.

4.5.2.2. Final evaluation of the Indigenous situation in the PGC region in the 1980s

It must be emphasised that the mega-programme PGC had no specific strategy on how to organise the living conditions and protection of the territories of the Indigenous population in eastern Amazonia. FUNAI, as the responsible agency, was not able to adequately solve the problems of the Indigenous people. This agency was dependent on political strategies, worked with a small budget, misuse of financial resources, persistent corruption, lack of qualified anthropologists and an incredible administrative chaos. In its 18 years of existence, FUNAI had 14 presidents. At least some of them asked to be dismissed because they became fully aware of their extreme limitations of action and the impossibility of achieving the goal of their work.

However, FUNAI faced a problem at a higher level. Neither the Military Government nor the subsequent democratic governments were willing to invest in Indigenous affairs, and they did not admit their indifference, lack of appreciation and understanding for the Indigenous people. Some of the activities were only carried out "para inglês ver," i.e., to satisfy the international public and to facilitate further foreign funding for development programmes. In the existing conflicts of interest, economic progress was much more important than social or environmental criteria. At the decision-making level, the Indigenous population in their regionally dispersed territories was still seen as an obstacle to the economic exploitation of Amazonia.

CVRD, as the main actor in the PGC programme, interfered in Indigenous affairs because the World Bank granted a loan to the CVRD that was tied to an agreement with FUNAI, which controlled the budget for a separate loan component for Indigenous people.[145] CVRD was blamed by FUNAI for the limited access to this budget. In fact, CVRD did not tolerate the financial resources being used to improve FUNAI's technical infrastructure, thereby neglecting the basic objectives of the loan. On the other hand, payments from the contract in 1985 represented only one third of the meagre total budget of this agency, which had to be used for the benefit of 6.5 % of the Indigenous population of Brazil.

The CVRD found itself in a very difficult situation. There were a number of obstacles due to FUNAI's organisational and management structures. Fieldwork of a group of consultants (anthropologists, medical doctors and a lawyer) and CVRD staff was hampered by obstructive FUNAI procedures and conflicting working concepts. The CVRD administration felt that the responsibility assumed for the Indigenous people

145 Cf. chapter I. 4.2.3.1

went far beyond the obligations of a mining company and the impact of its own project on a few Indigenous areas. In fact, since the 1982 contract agreement, *garimpeiro* activities, timber exploitation, waves of migration, chaotic land distribution in INCRA and GETAT projects, serious conflicts of interest between social groups, instability of federal and regional government agencies, uncoordinated PGC regional planning objectives and incredible land speculation had significantly altered the original contract terms.

Aware that CVRD was the only constant factor in "Indigenous policy" within the PGC region, there was a fundamental intention to resolve the ongoing problems. This was a matter of CVRD's high national and international reputation. CVRD officials felt that the constant disputes with FUNAI and the negative news about the development problems in East Amazonia became more and more associated with its activities. The involvement in the agreement became a burden on CVRD's image.

CVRD's environmental department dealt with the issues of the agreement with FUNAI, especially the financial transactions and monitoring. A small, competent team of very reliable people managed the various problems with a great sense of responsibility. This was not an easy task even within the company, because CVRD's basic objectives were mining and the export of mineral products.

Some Indigenous groups were no longer cooperative as they were confused by too many and divergent suggestions of how to protect them against the impact of PGC projects. Furthermore, they were disappointed by long administrative procedures and FUNAI promises still unfulfilled. The reactions of the Indigenous tribes changed significantly in view of projects, often undefined and implanted without previous consultation of the affected groups. Different stages of contact with the non-Indigenous population, attempts from outside to influence the decisions of the *caciques*, new leadership structures and consequences of "integration" caused complex problems. Especially bad "advisors" and dubious lawyers trying to gain money by "defending" the rights of the Indigenous people provoked reactions which were contrary to the traditional isolation and protection approach. The new "cash cycle" made tribal people tempted to sell timber or Brazil nuts and leasing land within the reservation to non-Indigenous tenants. This was illegal, but only on the condition of Indigenous people having no disposing capacity. Justified indemnification payments sometimes were used to buy absurd and expensive objects, such as a small airplane.

By 1986, only 40 % of Indigenous territories had been demarcated in the PGC region, but 31 % of the areas were invaded and 55 % of Indigenous territories were still not registered with the SPU.

In conclusion, there was a fundamental conflict at the moral-ethical level in addressing Indigenous problems within a regional development programme: the positivist mentality of granting financial compensation for the deprivation of habitat and the destruction of the cultural identity and self-determined economic existence of a minority that was the government's protégé under the Brazilian Constitution.

4.6. The PGC-Agrícola plan

The natural vegetation of most of the PGC region was rain forest with various forest ecosystems. The composition of the forests changed in the east and southeast with the increase of dry months. In the east, the occurrence of the *babaçu* oil palm (*Orbygnia martiana*) increased, resulting in extensive palm forests in Maranhão and northern Piauí. South of 8°S, the tropical rain forests very soon changed to the *cerradão* formation, a transitional forest vegetation with about 4 months of aridity and the *cerrado*, the savannah with 5 to 6 arid months.

As already mentioned, the immense biomass of the tropical rain forests is not an indication of good soils with high crop production. The region's soils are very poor and – in line with regional differentiation – there are severe limitations to sustainable agricultural production.

In the 1980s, most agricultural units were managed by sharecroppers (almost 45 %) and by squatters (up to 40 %). Landowners constituted a very small minority, but almost 90 % of the land belonged to them. Estates of 10 000 hectares and more grew considerably in the course of land upgrading. The unequal distribution of land in Maranhão was extreme (Gini index 0.927; Brazil: 0.86). The regions with the highest land concentration were those of traditional land tenure – semi-feudal *fazendas* – while the pioneer front regions of Mearim, Pindaré and Imperatriz still had lower land concentration. But as land values increased, so did the demand and pressure of the large landowners on the squatters.

The basic idea of the PGC agricultural planning in 1983 was to use the existing Carajás railway as a starting point for a broader development of regional agricultural production.[146] Three years earlier, a report had been submitted by a Japanese advisory group invited by the CVRD to assess the export opportunities that would be created by the coming railway infrastructure in the PGC region. This report called for an "export corridor" in which 300 livestock farms, each covering 10 000 ha, would be established. The level of investment proposed in official publications for the agricultural sector dropped from US$ 8.1 billion to US$ 1.8 billion in later revisions of the PGC Agrícola Plan.

The programme area was to be divided into seven "development poles": Castanhal, Bacabal, Marabá, Araguaina, Imperatriz, São Felix do Xingu and Balsas. The objectives of the plan were defined very superficially as follows (Ministério da Agricultura 1983, vol. 3, p. IV, 16–17):

- to contribute to increasing the agricultural productivity of the region,
- to stop the trend of forest devastation and degradation of natural resources,
- to make the agricultural sector economically viable and promote a full employment economy,
- to reverse the trend towards concentration of land ownership and promote the formation and consolidation of a layer of economically sound family farms.

In addition to the official objectives, there were other important reasons for the PGC-Agrícola that were not articulated in the plan's documentation: The establish-

146 Cf. Ministério da Agricultura (1983; 6 volumes).

ment of highly profitable enterprises in the most desirable locations for agribusiness interests, and the containment of discontent and violence that could disrupt projects contributing to the national economy (Fearnside 1986b). CVRD was undoubtedly interested in protecting its concession area from possible encroachment by squatters from nearby areas of land conflict.

The PGC-Agrícola plan served as an initiative for negotiating loans from the Inter-American Development Bank. The plan proposed different cropping systems for small, medium and large farms (80 – >500 ha). Planners believed that livestock farming was suitable for the region. Although the planners accurately described the land tenure problems and social tensions in the region, they were convinced that with the envisaged selection of more than 10 000 small production units and technical and financial support, the regional situation could be calmed down.

The government's strategy has always been to present the PGC Agrícola as a provisional version in order to be able to react as flexibly as possible to new land conflicts and protests by the rural population. At the institutional level, there was no clear responsibility for the implementation of the plan. The PGC-Agrícola plan never received its own budget. In 1986, the new head of the inter-ministerial PGC programme declared that he no longer felt attached to the PGC-Agrícola plan,[147] as it had been adopted by the previous government.

It was alarming that some parts of the plan had already been realised through sectoral planning activities using generally available credit lines. These projects include:

- subsidies to capital-intensive cattle raising, credits for rain forest clearing, investment in cattle and marketing,
- research in charcoal production,
- soybean or rice production in medium and big estates,
- an isolated irrigation project in the Mearim valley,
- subsidies in agroindustrial projects (e.g., *babaçu*-oil processing).

The lack of coherence of these projects, which were not targeted at the regional population but at companies from outside, certainly did not contribute to pacifying existing social tensions, but reinforced the process of uneven development and increasing socio-economic inequalities.

Smallholders live in better conditions than tenants or sharecroppers, who have to deliver 30–50 % of the value of their production to the *fazendeiro*. Most tenants suffer from additional dependencies, such as the need to sell their produce and buy the necessary staple products from the farm owner's local shop. Tenants were increasingly threatened by farm modernisation or the transition from arable to livestock farming, where most labour was no longer needed.

The fundamental problem in the PGC region was land tenure. Unfortunately, as in most rural areas of Brazil, many land titles must be considered semi-legal or illegal. This situation was familiar from Brazilian settlement history, in particular from the pioneer areas. The seizure of land was rarely accompanied by an official land register.

Neither the State Land Regulatory Authority nor INCRA were able to establish a functioning land registry in the region. There was a real need for a land regulatory

147 Interview with the author on 2 September 1986; cf. Kohlhepp *et al.* (1987, 186).

authority that was able to calm violent land conflicts and that could provide a basis for legal and equitable land distribution and registration.

For this reason, GETAT (land authority of the Araguaia-Tocantins region) was created in 1980, responsible for about 50 % of the PGC region, mainly in the south-east of Pará and the west of Maranhão. GETAT's main tasks were land surveying, registration and the establishment of colonisation projects such as Carajás II and III or expropriation for land regulation. In the first half of the 1980s, the military regime made the last effort to reorganise the economic, social and political structures in Amazônia Legal by concentrating all decision-making power in the National Security Council (SNI). GETAT – completely independent of the PGC administration – was entrusted with three overarching tasks (Branford and Glock 1985, 156): 1) creating a new order of legal land access, 2) creating a new regional political base and 3) undermining the influence of the church in the region.

The first long-term goal could not be achieved, as national, sectoral and regional development policies were at odds with regional needs. The second objective was successful because the political "climate" has changed since GETAT tried to intervene. The third objective was temporarily achieved. The power of GETAT, its cooperation with the SNI and the state's policy of repression and intimidation created a situation of constant surveillance and fear, especially until the end of 1983.

Since 1952, the Catholic Church of Maranhão has been involved in programmes to support the rural population in order to reduce social conflicts between landowners and farm workers and tenants. In 1960, the Archdiocese of São Luís launched a pilot land reform programme. The Church purchased an area of 130 km² and distributed land to rural families without sufficient arable land. The Church supported the creation of unions of independent peasants in 1963, although the local political power and the government tried to prevent any form of social protest. At the end of 1963, the National Federation of Agricultural Workers (Confederação Nacional dos Trabalhadores na Agricultura, CONTAG) was formed to represent all agricultural workers' unions.

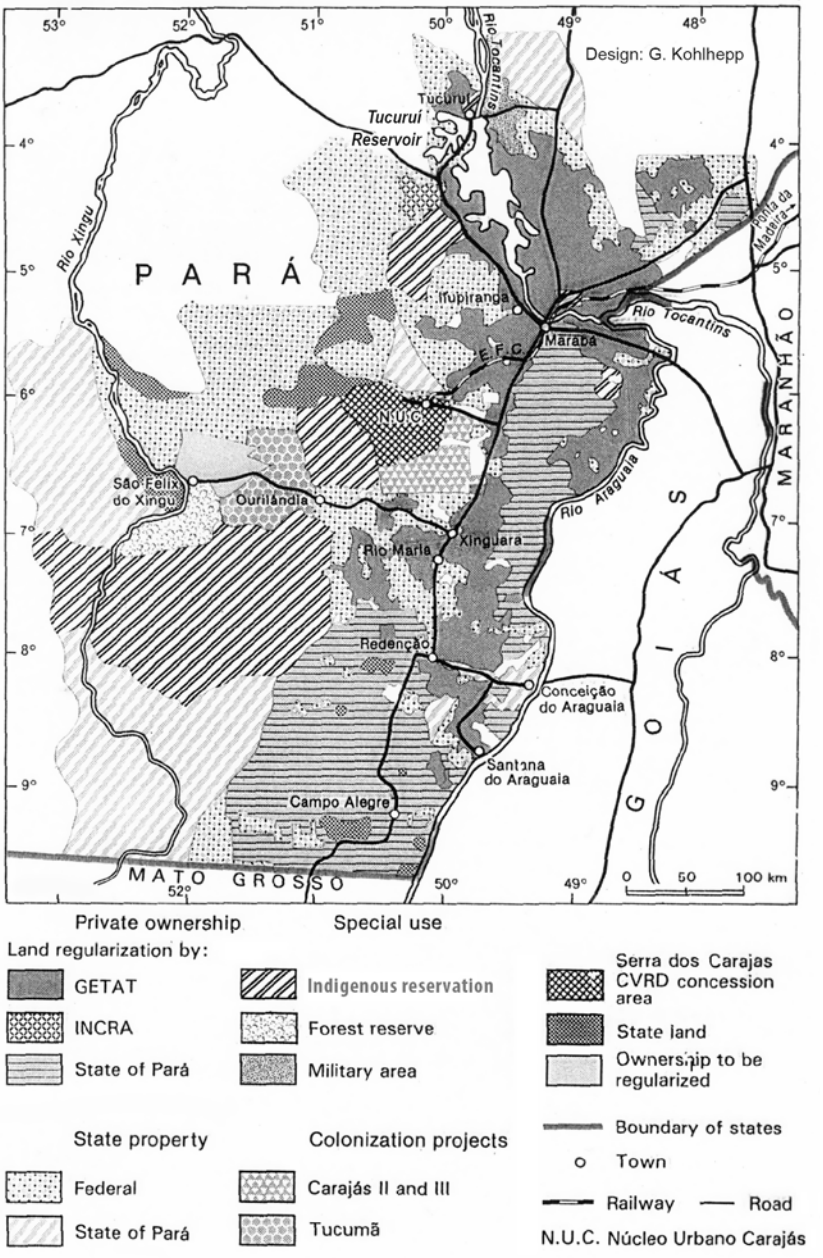
After the 1964 military coup, the government retained the organisational structure of CONTAG, but intervened and eliminated its political functions. The leaders of the local union representatives were appointed by the state and thus no longer represented the rural poor. Despite the state repression, the autonomous underground unions continued their activities. In Maranhão, the bishops did not publicly support formal demands for social change until 1973. However, the priests in the parishes, often young men from Europe, tried to convince the rural population to defend their rights and organise. The development policy of SUDAM in the 1970s, with large-scale land ownership, enormous actions of illegal land occupation, increase of land prices and forcible eviction of land squatters, led to a renewal of social commitment by the official church representatives in Maranhão.[148]

In 1975, the Amazonian bishops founded the Comissão Pastoral da Terra (CPT), an ecclesiastical support service for the rural population that helped them obtain land titles or defended their rights against oppression and eviction. Soon, the government regarded the clergy as a leading component of the social movements in the rural areas, arguing with the accusation of "communist" infiltration. The CPT in Maranhão documented land conflicts, murders and violent actions against land squatters and small

148 Kohlhepp *et al.* (1987); the part about Maranhão has been elaborated by Reinhold Lücker. Cf. Almeida (1982); Asselin (1982).

farmers. Several foreign priests had to leave the country, some were attacked or killed. Although repression against active local priests increased, the government could not diminish the important political influence of the church in the region.

Fig. 18: Land ownership in the Southwest of the PGC region



Source: Cf. Kohlhepp (1987b, 230); based on documents and maps of CVRD and GETAT.

Police or SNI violence against priests, lay brothers, and trade union leaders had decreased since 1984. In the regions most affected by social tensions, the priests not only fulfilled their religious duty, but also worked as agricultural advisors or directed social defence. The open conflict between the church and the state culminated in the formal excommunication of the former governor of Maranhão in March 1986.

Land tenure in the PGC region was an extremely complex problem due to the interference of numerous authorities, federal and regional entities and a number of divergent laws on access to land and land titles. The situation in the southwest of the PGC region in Pará illustrates the prevailing problems (see Fig. 18).
In addition to the existence of land titles granted by INCRA, GETAT and the state of Pará, or land owned by the federal government (*terra devoluta*) or the state government of Pará, there were areas of special use: Indigenous reservations or areas not yet registered, forest reserves and military areas. There were also special colonisation projects of GETAT (Carajás II and III) and areas given to companies (Tucumã) for colonisation. CVRD had a high-ranking position in land ownership with its Serra dos Carajás concession area for the iron ore project as the core project of the Programa Grande Carajás.

The predominant problem on the pioneer front is always the rapidly expanding land occupation without any regard for existing land titles and boundaries of properties, Indigenous reservations or projects. An example of the advancing pioneer front was the region between Marabá and Xinguara (Fig. 17), which showed the inability of official bodies to organise this settlement process accompanied by uncontrolled deforestation.

The largest municipality in the GETAT study area was São Félix do Xingu with 116 500 km². More than 25 % of this area was allocated to large companies involved in logging, mining and private settlement. 29 companies owned 1.3 million ha, or 11 % of the municipality's area (Almeida 1986). A large area (0.4 million ha) was awarded by INCRA after an auction to the construction company Andrade Gutierrez in the Gleba Tucumã (Morán 1987) between São Félix do Xingu and Xinguara (see Fig. 18) for private settlement with plots averaging 86 ha and better soils than in the Carajás II and III GETAT projects. The company built the village of Tucumã and provided a good infrastructure of access roads. Most of the settlers came from Rio Grande do Sul and had left their home families of *minifundistas*. Many of them had no experience in agriculture. As the company's economic expectations were disappointed and hundreds of squatters had invaded the area in the meantime, the original project was abandoned in 1987.

GETAT was mainly active in the area of the "agricultural poles" Araguaina, São Félix do Xingu, Marabá and Imperatriz. In these areas, GETAT created the basis for an export-oriented production of timber, meat, soybeans and cereals in accordance with JICA's planning strategy. The valorisation of this region was seen as the result of large-scale, capital-intensive, market-oriented agriculture, which was completely at odds with the basic needs of the poor, landless rural population. This population was seen by the decision-makers as an obstacle to regional progress.

72 % of all land titles belonged to peasants with less than 100 ha, i.e., only 5 % of the land in question. Many plots of land did not reach a size sufficient for a production unit of a family.

With the Carajás II (1983) and III (1982) projects, east and south of the CVRD concession area (see Figs. 13 and 18), GETAT established two peasant settlements which offered less infrastructure and services compared to INCRA's colonisation projects on

the Transamazônica. The regional development centres (Cedere) with state administration, primary school and health centre had a simpler structure than those of the Polonoroeste programme in Rondônia. The settlement was realised with a minimum of costs and as quickly as possible, as the pressure from the large landowners in the region increased.

In Carajás III, the number of plots sold was reduced from 4000 to 2000, and the size from 50 to 25 ha. The upgrading of the land through the construction of the road from Marabá to Serra dos Carajás increased the pressure of land speculators. The idea of settling farmers from southern Brazil with technical training in agriculture as trainers for the other farmers had no positive effect. Their knowledge did not work in the Amazonian region, and they were disappointed by the restrictions to focus on annual crops. Moreover, the intention to give advice to the other farmers was not accepted (Fearnside 1986b). The situation in Carajás II was strongly influenced by the greater distance to the road and especially transport problems occurred during the rainy season.

In the PGC region, land conflicts prevailed to such an extent that violence and pressure from the large landowners decisively influenced the decision-making level of strategic planning. The needs of smallholders were not translated into viable and politically implementable solutions even after re-democratisation.

In the PGC region, the reasons for land conflicts were as follows:

- Very unequal agricultural structures with a growing proportion of rural families without access to land tenure;
- Traditional forms of land ownership in large landholdings (*latifundios*) with a paternalistic role of the landowner towards his tenants and farm workers and with the role of the landowner changing to a capitalist entrepreneur;
- *Grilagem*: The illegal occupation of state land or occupied land by large landowners, merchants, politicians or corporations, mainly for purposes of expansion or speculation, with the resident population threatened and forced to leave the land or surrender up to 50 % of their crops. Land titles were often obtained by presenting forged documents, forgery, bribery and other forms of corruption. Illegal land occupation was often defended by the new landowners with violence and the help of *pistoleiros*;
- In the *cartórios*, the offices where land titles are granted, these titles could sometimes be illegally prepared, "bought" and registered, leading to confusion and counteractions by the defrauded population;
- Demographic increase in the rural population with no chance of land ownership;
- Immigration of migrant groups from other states, especially from Ceará, Rio Grande do Norte and Bahia;
- National development policies that favour the establishment of large-scale landholdings in cattle breeding or arable farming, especially by migrant companies from the South or Southeast of Brazil. In many cases, landowners organised their lands in absentia and appointed administrators to oversee the work on the *fazendas*;
- Invasions and appropriation of tribal lands by squatters, prospectors or large landowners.

The regions with the most violent conflicts had shifted from Araguaia river and southern Maranhão to south Pará and the rain forest area in western Maranhão in the early 1980s. In 1985, there were 140 murders in land conflicts in Pará (97, mainly in the Xingu region) and Maranhão (43) (Kohlhepp *et al*. 1987, 182).[149]

The increase in violent conflicts is certainly also related to the agrarian reform (PNRA law) promulgated in 1985 (MIRAD 1985). *Grileiros* and large landowners feared that the existing squatters would claim their own property rights on their land if the land reform was implemented, and therefore tried to get their land "clean," as they called it.

On the other hand, the squatters became better informed about their rights and the process of eviction through information campaigns by the church and rural associations. New forms of cooperation developed among squatters, which could be described as mutual assistance in self-defence. There was a tendency for squatters to arm themselves, and some were enlisted as *pistoleiros* to defend rural communities (MIRAD 1986, 51 ff.) against *pistoleiros* of *grileiros* or other large landowners. These vigilante measures became increasingly common. One reason for these illegal conditions was the lack of help from the local police or official courts to defend the human rights of the affected land squatters and small landowners.

Along the Carajás railway line to Ponta da Madeira/São Luís, the smallholders had no official support. Permanent pressure from large landowners, no political interest in securing the smallholders' land titles, "accidental" forest fires, and delays in the construction of roads to transport agricultural goods to the railway station made life difficult for the settlers. The settlement of farmers in the areas along the railway line was prevented with many political tricks and the threat of *pistoleiros*. The resistance and resilience of the rural population had already weakened in recent years and resignation spread.[150]

The rural atmosphere in the regions of São João do Araguaia, Marabá, Vizeu (PA) and Imperatriz was more than tense. Land conflicts were recognised as a kind of civil war in a documentary annex to MIRAD (1986). This unbearable situation led to an exodus from areas of social tension. The share of the rural population in Maranhão stagnated, and in several municipalities, there was a net decrease in absolute numbers. Most of the rural exodus was directed to the urban centres.

The Military Government (1964–1985) had obstructed open discussion of agrarian reform and persecuted its protagonists. Instead of an agrarian reform, it formulated the alternatives of modernising agriculture and colonising Amazonia. The covert discussion on agrarian reform increased from 1983 onwards, essentially determined by the grassroots church communities that formulated and stimulated the protests of the peasants and landless rural population.

The 1963 Agrarian Reform Act was transformed into regional agrarian reform programmes in 1985, which identified priority projects within the states. The aim of these projects was to settle squatters and agricultural workers on expropriated, unused land,

149 Data from the Ministry of Agrarian Reform and Agrarian Development (MIRAD 1986, 83-84) and reports of CPT.

150 Interview with Frans Gistelinck, in São Luís, September 23, 1986 (cf. Gistelinck 1988). Brazilian President José Sarney, as governor of Maranhão (1966–1970), had also mentioned years ago that the problem of squatters and small farmers could be solved by migration.

especially on large plots where there had been repeated serious land conflicts. Landowners were to be compensated in the sense of a conservative land reform. For the majority of the Brazilian population, it seemed clear that the agrarian reform (Ianni 1979a) should be carried out. However, a strong opposition soon formed within the centre and the right wing of the PMDB political party. The UDR, a newly formed and growing group of large landowners, concentrated its protest against the consequences of the planned agrarian reform. Most of the MPs in Brazil belonged to the urban bourgeoisie and were open to the big landowner groups. After the November 1986 elections, the agrarian reform programmes were considered secondary, and the political discussion focused on the Constituent Assembly. In 1987, the political majority for agrarian reform was lost and it became clear that the existing social structure of rural areas would not be fundamentally changed in the near future. The legal possibility of expropriating underused large estates remained very limited due to the lack of financial means for compensation.

Development policies in Amazonia have increased the demand for land, unfortunately also for speculative purposes. Capital groups from South and Southeast Brazil used the unique opportunity of tax incentives to seize very large areas at very low land prices in relation to their home regions. Apart from some state-controlled colonisation projects, small landowners could not withstand the enormous pressure of legal and illegal land acquisition. The land problem took on a new dimension and social tensions and violent conflicts of interest dominated the rural scenario (J. Martins 1982 and 1983; Hébette 1986). Land in Amazônia Legal was offered on the national and international land market, excluding most of the region's inhabitants who were not fully integrated into the cash economy.

The PGC-Agrícola plan missed an invaluable opportunity to orient agricultural development towards socially and culturally appropriate and sustainable forms of production in order to meet social needs of the regional rural population and to achieve socially balanced regional development.

4.7. Final considerations about the Grande Carajás programme (PGC)

In analysing the PGC, it must be emphasised that, as a regional development programme for eastern Amazonia, it can be characterised as an administratively and functionally inefficient, institutionally uncoordinated and vertically incoherent mega-programme. The objective of verticalising regional planning, i.e., decentralising spatial planning decisions and involving the affected population of the region, was not achieved. The Grande Carajás programme was perceived by the regional population as an "attack on the heart of Amazonia" (Pinto 1982). A new integrated regional planning approach, which would have been urgently needed, was not realised after the political change in the mid-1980s.

The PGC was not a "precisely defined development plan, instead taking the form of a legal framework for the granting of state subsidies to promote projects specifically aimed at achieving integration of Brazil into the world markets" (cf. Deutscher Bundestag 1990, 316). As a large-scale development programme in the Brazilian planning region Amazônia Legal, the PGC had been implemented without its own budget, without sufficient technical staff and without taking into account the needs of a large part

of the regional population. It represented the pattern of a "development from above" with numerous negative social and environmental consequences. The follow-up costs of large-scale projects and the coordination of planning at the municipal level had been neglected financially and operationally. Tax incentives for large-scale projects had reduced tax revenues flowing into the municipalities (Binswanger 1987; Mahar 1989).

After a multitude of macro-planning – and in certain cases "pseudo-planning" (Ab'Sáber 1989) – and predatory proposals for the Amazon region, there had been several proposals and scientifically sound studies on ecological, economic and agro-ecological zoning. The concept of ecological and economic zoning required a multidisciplinary analysis to determine the specific possibilities of priority objectives for each sub-area of the territory concerned, in accordance with the criteria of ecological development (Sachs 1980; Kohlhepp 1983b; 1987c; 1991c). "The simplistic idea that certain ecological spaces should be matched by economic spaces, in a totally adjustable overlapping set-up" (Ab'Sáber 1989, 5) is not acceptable. There is a risk of misuse or misinterpretation by the administration. The basic problem is that land use planning as a provisional measure has only a theoretical value. It must serve as a "guideline" for future development, but the reality of current land use may completely contradict the results of zoning or at least differ significantly from them. The crucial issue lies in the methods and policies for rezoning space – and land tenure – in line with the ecological and socio-economic "vocation" of the respective sub-areas (Kohlhepp and Schrader 1987).

There was a lack of clear definition of the intended spatial organisation based on studies of environmental and socio-economic conditions and their intra-regional differentiation. Major projects should only have been put into operation after studies on environmental impacts had been completed. The cost of protection against environmental degradation should be included as an integral part of the project cost. Information of the Amazonian population affected by these projects was inadequate and delayed. The resettlement and compensation measures were carried out without the right of objection and co-determination of those affected and without consultation with the respective competent regional and local authorities.

The programme region did not receive an adequate share of the profits from the exploitation of mineral resources in large-scale projects. Small and medium-sized projects of social relevance that are ecologically and regionally adapted were urgently lacking. Although there was already an awareness of the social and economic consequences of large-scale projects in other Brazilian regions, integrated planning measures were very rarely implemented in Amazonia.

The Programa Grande Carajás (PGC), with its enormous volume of investment and the government's old style of "development propaganda," attracted large masses of migrants. The iron ore project as "the heart of the PGC" occupied only a limited concession area in the Serra dos Carajás and was organised by CVRD in an environmentally sustainable way. Nevertheless, the associated projects and the almost uncontrollable spontaneous development processes, especially outside the spatially limited projects, have led to an almost chaotic situation in the PGC region (Almeida Jr. 1986; Kohlhepp 1987b; 1987c). The construction of paved roads, the Carajás ore railway, the new deep-sea port Ponta da Madeira near São Luís, the construction of the reservoir and the large-scale power plant in Tucuruí with its widely ramified electricity distribution network, as well as the huge aluminium smelters in Barcarena near Belém and in São

Luís have triggered a massive influx of people. The danger of enclave formation was inherent in these mega-projects (Kohlhepp 1991c; 1997b).

The pig iron and other metallurgical projects in the PGC region, using charcoal as an energy source and reducing agent, led to a new wave of tropical forest destruction. There were divergent opinions in the CVRD administration[151] when evaluating charcoal-based pig iron projects. Considering the environmental costs, it would have been advisable to resort to non-predatory alternatives such as importing coke, even using international loans. The costs of social and environmental impacts of large-scale projects must be adequately considered in the long run.

The overlaying of the region's traditional, social and economic structures by new spatial structures and the socio-economic disparities within the region, exacerbated by polarisation effects of mega-projects, contributed even more to regional disintegration and widespread spatial and social segregation (Hébette 1985; Hemming 1985; Kohlhepp *et al*. 1987; Hall 1987, 1989; Fearnside 1989d; Kohlhepp 1991c).

The lack of regional participation in all sectors reinforced the "syndrome of the periphery of the periphery", i.e., the surrender of affairs to decisions from outside, both at the national and international level: the so-called "integration" into the world market under extremely unfavourable trade conditions (Altvater 1987a; Kohlhepp and Schrader 1987; Nitsch 1989; Kohlhepp 1995).

The PGC-Agrícola appeared as a kind of "appendix" of the PGC and almost excluded the fundamental problems of smallholder agriculture. It lacked a new strategy of integrated rural development, which could not be achieved without an agro-social structural change and a concomitant appeasement of rural violence (Ianni 1981; J. Martins 1982 and 1983; Hébette 1986). Unfortunately, priority was given to the large landowners. The problem of land ownership with forged land titles could not be solved. Sustainable land use models were disregarded, and livestock and soybean cultivation became predominant. Private colonisation projects favoured migrants, especially from southern Brazil. In the PGC, appropriate infrastructure and extension services were not provided by GETAT and INCRA to small farmers. The landless rural population of the PGC region had very difficult access to land and remained marginalised. Smallholder agriculture projects should have been accompanied by intensive advisory services on a cooperative basis and integrated into communal development programmes. There was a lack of political will to support the participation of the local rural population and to respect intellectual property rights with regard to strategies of helping people to help themselves.

Numerous conflicts of interest on the pioneer front, spontaneous land occupation, disregard for Indigenous reservation boundaries, dangerous legal uncertainty, the constant intensification of land use conflicts and ever scarcer land meant that the coexistence of competing social groups and their economic goals created almost insoluble problems of coordination. This underlined the lack of common development goals for Amazonia.

Obviously, the meaning of the PGC-Agrícola plan was purely a political strategy under the conditions of the last "abertura" period at the end of military governments. The theoretical background and the strategies chosen were not significantly different

151 Interview of the author with the CVRD Vice-president and the Superintendent of Planning at Serra dos Carajás, September 1./2., 1986.

from those of the 1970s, when the growth pole strategy and general economic growth policies prevailed. There was no sign of a serious regional development strategy.

For a long time, Amazonia was seen, both in Brazil and abroad, as a source of natural resource exploitation, often mistakenly considered as "unlimited." Spatial organisation took the form of the misuse of Amazonia in terms of unconditional valorisation in the sense of an "inland colony," without regard to environmental and social conditions and without the regional population having opportunities to satisfy their basic needs. The geopolitical concept of Amazonia as a vast empty space, as reflected in the regional planning of the last decades, was a fundamental mistake.

Amazonia must not be made the object of speculation and investment for the purpose of tax advantages in the interest of companies outside Amazonia. The tropical forests of Amazonia must no longer be a field of experimentation for so-called "development models" that are ecologically and socially unsustainable and a field of manoeuvre for different groups of non-Amazonian interests.

In Brazilian history, many politicians and social actors on the pioneer front considered Indigenous tribes in the rain forests as enemies that prevented economic progress. To this day, parts of the neo-Brazilian population fundamentally do not respect the rights of the Indigenous population to their own living space as guaranteed in the Constitution. Indigenous groups were identified as obstacles to social advancement or to the profit maximisation of the invaders of their territories. There was a lack of awareness of the unjustified persecution of a vulnerable ethnic minority, a lack of understanding of their need for space to hunt, gather and for their shifting cultivation. This was the situation at the beginning of the Grande Carajás programme in the 1980s during a military regime convinced that it had a unique opportunity to solve the "Indigenous problem" in its own authoritarian way without the slightest ethnic, social and environmental scruples.

Considering the Indigenous population of Central and East Amazonia, it was a fatal mistake not to provide protecting measures in all parts of the PGC region. Regarding the institutional weakness of FUNAI, after re-democratisation the new government did not succeed in effectively reorganising this public institution and improving the financial conditions and the qualification of the staff. Donations from international organisations for projects to protect Indigenous peoples, as well as support for local and regional NGOs, should have been welcomed and not rejected because of nationalist or political reservations.

An urgent demarcation of Indigenous territories, demarcation and – if necessary – control and re-demarcation taking into account the basic ecological, socio-cultural and economic needs of Indigenous groups did not take place. Territorial integrity should have been ensured by spatially contiguous territories for related tribal groups. Much too late and only partially, the full participation of Indigenous representatives was included in all operational arrangements. An institutionalised advisory group of renowned Brazilian anthropologists should have been established in cooperation with official bodies. The Indigenous population must decide on the objectives of further actions in favour of an undisturbed Indigenous way of life. Regional information campaigns to strengthen public understanding of basic Indigenous needs were completely lacking.

In case of unavoidable impacts of development projects, the amount and use of compensation for Indigenous groups should be determined and monitored by a special

commission consisting of Indigenous representatives, their legal advisor (non-turnover lawyer), specialised anthropologists, a FUNAI officer and members of local/regional non-profit NGOs.

The PGC used CVRD's highly qualified staff and national as well as international reputation to achieve important political goals without taking care of the social and environmental issues. This raised the question of for whom in Amazonia the mega-programme and its "development" was ultimately planned.

As a "warning shot," the Grande Carajás programme had a significant influence on the situation in Amazonia in later decades. It was the starting point for considerations on an urgently needed sustainable development of Amazonia, which was then attempted to be realised in the International Pilot Programme to conserve the Brazilian rain forests (PPG7).[152]

152 See chapter II.1.2.